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APPLIED HYDRAULICS

THE MAGAZINE OF FLUID POWER TRANSMISSION

OVEMBER, 1949

- HYDRAULIC CIRCUITS
- HYDRAULIC CONTROLS
- IR CIRCUITS
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- ELECTRICAL AND ELECTRONIC CONTROLS

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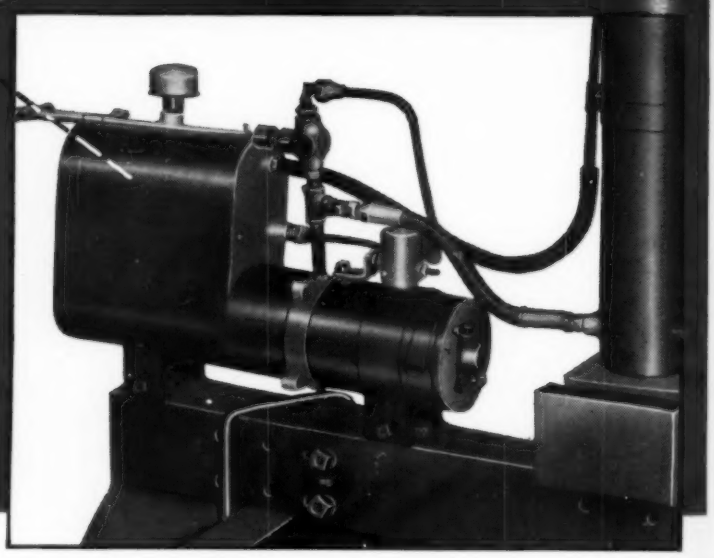
A Dump Truck on a ½ Ton Pick-Up



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NOVEMBER, 1949

Vol. 2 No. 10

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FRONT COVER: A high speed universal plunger molding press at Tech Art Plastics Co., Long Island City, N. Y. Fully hydraulic and operating on a straight compression cycle, the presses have raised production 25 percent over transfer molding equipment previously used. The operator is shown removing a finished radio cabinet of ivory urea from the press.

Photo courtesy, The Baldwin Locomotive Works

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REQUIREMENT

The J. I. C. HYDRAULIC STANDARDS FOR INDUSTRIAL EQUIPMENT, SEC. H6.1.5, states: When suction strainers are provided they shall be of ample size to strain more than double the intake capacity . . .

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LETTERS to the Editor

Can you suggest an automatic device to deliver an air blast at end or between strokes of a very small 1 inch stroke high speed power press, driven by motor from light circuit. The device must be compact for attaching to press and there is no source of power available other than 110 v light circuit and the press.

W.C.C.

We would recommend that this be accomplished through the use of a small solenoid valve controlled by electric limit switches actuated by a linear cam attached to a moving part of the press. A valve of this type is manufactured by Skinner Electric Valve Division, Norwalk, Conn. We would suggest that you discuss your problem with them.

E.L.F.

It is apparent from your letter that you do not have a source of compressed air at the power press. It therefore becomes necessary to generate the air blast from the motion of the press; the job calls for something in the nature of a small bellows or an air pump. It may be that you can hook-up one of our inexpensive air cylinders to act in reverse. Before we can recommend a suitable cylinder we would have to know how large a blast you require. If you will tell us what is to be blown away and send us a sample, we can make tests here to see what is required.

T.E.M.

I wish to pass on some information to C.H.B. (letter in the September Letters to the Editor column) for I think he may obtain a hydraulic fluid for use in his machines which will be satisfactory for the stated purpose and yet which can be washed off any work piece by cold water. I refer to the "UCON" synthetic lubricants. Our first experience with these synthetic fluids was in April, 1947, on a job for which we had supplied a Hele-Shaw pump. The installation required the use of hoses and not long after the unit was started up, a hose burst and sprayed oil on a large furnace nearby. The resultant fire was quite serious and the customer came to us for a non-flammable hydraulic fluid to prevent a re-occurrence. After some searching we contacted Carbide and Carbon Corp., and charged the system with their "Hydrolube 550-N", a water soluble and therefore non-flammable fluid. The unit was again put in operation and although there were other hose failures, there never was another fire. At the end of July of the same year, the pump was taken apart for inspection and was found in perfect condition with no evidence of wear. It was re-assembled, and, so far as we know, is still in operation.

L.A.L.

We manufacture, among other things, a farm harrow. This harrow is made up of 3/16 x 1¼ flat iron with cast iron teeth attached. We have been putting ⅜ in bolts in to hold the teeth in place. Over a period of time these bolts stretch and become loose. I would like to put in a cold rivet and, if possible, build a rivet squeezer in my shop. Suggestions or details will be much appreciated.

D.E.S.

The names of several manufacturers of hydraulic and air components that might be utilized and of one or two distributors in your territory who can be very helpful, have been sent to you.

We have examined two or three examples of the new hydraulic circuit diagrams using J.I.C. symbols and, while they are somewhat clearer than the previous practice of many manufacturers, we would like to suggest the addition of the sequence of operations on the print. We have seen this done in one or two cases and it has been a big help in understanding the circuit and in trouble-shooting. I hope, if you print this, that the members of the J.I.C. committee responsible for the diagrams, see this.

J.K.

Thanks for your suggestion. We think it is a good one. In fact, we have in preparation several articles in which sequences of operation have been placed directly on the diagram of the circuit. Also, we will personally pass along the suggestion to members of this committee. We suspect the idea won't be too hard to sell, as one of the circuits with sequences of operation is being furnished us by a member of the committee.

Do you have a check list of the articles which appear in APPLIED HYDRAULICS that have been republished? There have been several articles which we wanted to keep for reference in issues that have become lost and which you write us are exhausted. Such a check list would be very much appreciated.

F.Z.

No, we do not have such a list. However, we did compile a list of the articles which appeared in the first year (February 1948-January 1949) and we will also do the same this year. With a few exceptions, we cannot supply back numbers older than three months.

I agree with T.M.'s question about a "How to Do It" column or page. I am enclosing a print of a job that cost me a lot of sleep. The notes explain what we have tried to date. I would like for someone else, with a fresh point of view, to make a suggestion or two.

H.B.

The "How to Do It" column is making some headway and we will start such a department, probably with our January issue. Other readers are invited to send in their tough problems. We probably will award cash prizes for published items. Any design, operating or maintenance problem will be eligible.

COMPACT *Series "K" Roper Pumps*

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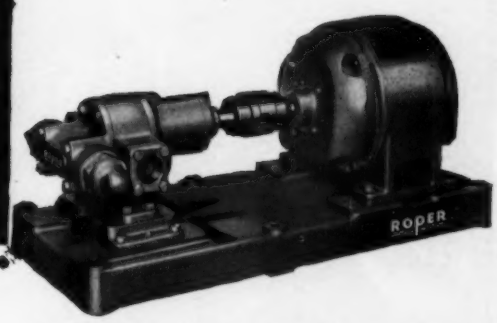

Fig. 26K Motor-Driven Pump Unit with built-in relief valve head is available in all sizes. Also Fig. 25K with head less relief valve. Includes bedplate and coupling to suit standard motor frames. Furnished with or without motor.

Fig. 1K Pump Head with packed box, built in 5, 10, 15, 20, 30, 40, and 50 g.p.m. sizes. Fig. 2K has built-in relief valve. Mechanical seal available on all models.

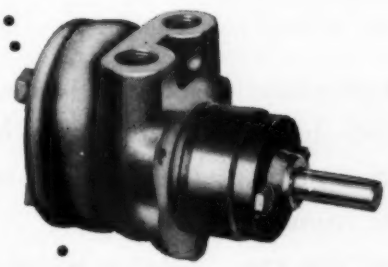

Fig. 17K Pump Head with mechanical seal. Capacities ¾,1½, and 3 g.p.m. sizes. Packed box is available. Fig. 18 K is equipped with built-in relief valve.

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FOR ALL HYDRAULIC UNITS

The J. I. C. Performance Standards for Tubing and Tube Fittings . . . .

A survey of the performance standards set by J.I.C. for tubing and fittings. The high-level performance, based on Specification AN-F47, assures a reliability and efficiency for industrial applications comparable to that provided by aeronautical fittings.

By ROBERT H. DAVIES

THE HYDRAULIC STANDARDS adopted by the Joint Industry Conference last year have seen a steady increase in acceptance on the part of hydraulic components manufacturers and the builders of standard and special machine tools, hydraulically actuated or controlled, for production use. Originally applying only to metal working and assembly machines built for delivery to automobile producers, there is now little question that the acceptance and use of the standards will eventually encompass all of industry. For this reason it becomes important that those who design, buy or operate hydraulic equipment examine the standards quite closely, not only for actual content but for an understanding of the overall philosophy of the standards as well.

The subject of physical circuits—comprising tubing and tube fittings—as covered by the J. I. C. Hydraulic Standards for Industrial Equipment is typical of the intent of the conference's work. For example, some of the requirements under Section H4, "Piping, Fittings and Fluid Passages", serve to simplify application or maintenance by specifying dimensional standards for circuit elements. A size range for tubing OD is listed, with specific diameter increments, to simplify selection and application. A standard flare angle (37 degrees) and standardized flared fitting nose dimensions, specified when a flared design is used, simplify actual installation and maintenance operations for this type of fitting.

Much more important, however, are the requirements which set a new high standard of physical performance for circuits under the most rigorous service conditions.

It is no secret that in many plants shifting back to peacetime production following the war, hydraulics earned itself the reputation as being the black sheep of the power family. Under the impact of war conditions, with lack of proper parts, unskilled operators and makeshift maintenance operations, many hydraulic mechanisms had degenerated to the point where top management had just about decided to bar the plant plant to any type of hydraulic machinery.

Such a situation called for strong medicine, and it was against this background that the new standards were formulated. Sights were set high in drafting the specifications, and a new high in hydraulic performance and dependability is to be anticipated. Such performance will undoubtedly pave the way for much wider application and usefulness of hydraulics, both in power and in control applications.

This matter of performance in fact constitutes the heart of the fitting specification by requiring [H4.1.6 (B)] that the performance of any connector used shall equal or exceed the performance of the Joint Air Force-Navy (Aeronautical) Standard fitting when tested in accordance with Air Force-Navy Specification AN-F-47.

It may seem extreme, at first glance, that industrial machinery be supplied with fittings that have the same unfailing performance characteristic of those used in military and commercial aircraft. However, when high production costs are considered, along with the effects of shutdowns due to hydraulic failures—particularly under production line conditions—it is evident that the standard has much to recommend it.

In the final analysis, no hydraulic mechanism is any better than the physical circuit which interconnects its components. Industrially, hydraulics must compete with electricity and other systems on the basis of reliability first of all, before any actual operating advantages can even be considered. It is imperative that the best available mechanical circuits be applied to all designs as a matter of course.

The AN-F-47 (and now the J.I.C. Standard) Qualification Specification involves a long sequence of controlled tests which approach an accelerated service as closely as it is

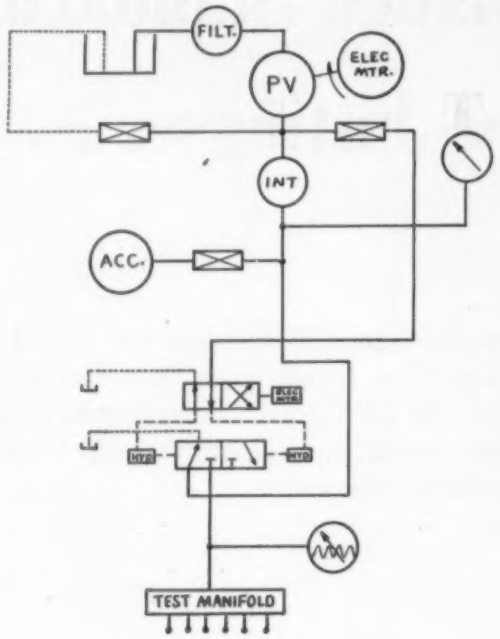


Fig. 1. Variable volume pump supplies 600 psi to the booster and cycling four-way valve. The booster makes 3000 psi available to the accumulator. An electric motor drives a variable speed transmission, which by means of a crank arm, actuates the four-way valve at the rate of 35 cycles per min; this, in turn, operates the four-way pilot operated reversing valve, transmitting 3000 psi to the test manifold. The needle valve controls the system peak pressure by controlling the flow to the piston end of the pilot operating reversing valve. Initial peak pressures of 1.5 times operating pressure are induced on the test manifold.

possible in the laboratory. It requires repeated make-up, hydraulic impulse (surge), combination mechanical vibration and hydraulic impulse, overtightening, burst and leakage tests over a wide range of operating temperatures. It requires that a minimum of three assemblies, comprised of six of the qualifying fittings for each specific test, undergo a rigid testing sequence in direct comparison with an equal number of assemblies of the AN standard fittings which are tested concurrently. Thirty fittings in each of seven sizes, or a total of 210 samples, are required to complete this testing program in establishing the merit of a fitting design and accuracy of manufacture.

Sealing Tests

The first series of tests proves the sealing capacity of the fitting and its ability to withstand blow-off at tubing burst pressures under various conditions of tightening and, by repetition, also demonstrates the efficiency of the fitting in reuse, after a number of assembly and reassembly operations.

Under minimum wrench torque, the tube and fittings are assembled and disassembled 15 times, each tightening operation involving complete prior removal of the tube from the fitting. After each third assembly, the assemblies are subjected to fluid pressures of 6000 psi for five minutes, with no leakage permitted.

At no time during the operation may the assemblies be difficult to tighten, nor may any components be damaged or deformed in the process. After the final (fifteenth) assembly, the test samples are subjected to the burst pressure of the tubing (or four times the working pressure, whichever is the lower) for a period of five minutes. There must be no blow-off of the fitting and no evidence of fluid leakage.

This procedure is then repeated using the maximum recommended torque for assembly. The fittings again must withstand the five static pressure tests and final extreme pressure test without blow-off or leakage. The procedures are repeated a third time, using an over-tightened torque equivalent to 2½ times the recommended maximum torque in sizes up to 1 in tube OD, and at least 1½ times the maximum for larger sizes. Again, the fitting must successfully pass the same extreme pressure test.

Impulse Tests

The same assemblies made up with minimum torque and those made up with over-tightened torques are then subjected to impulse testing to prove their resistance to surge pressures. They are subjected to an impulse cycle, constituting a rise from 0 psi to working pressure (3000 psi) and back to 0 psi at a rate of 35 cycles per minute. Upon each impulse application and initial peak surge pressure of 1.43 to 1.57 times the working pressure must be obtained as evidenced by a cathode ray hydrauliscope. After 100,000 impulses at workroom temperature, the assemblies are held for 24 hours at minus 65 F under from two to ten pounds static pressure. They are then subjected to a second 100,000 impulses at the low temperature.

A static pressure test at four times working pressure (or at the burst pressure of the tubing) then establishes the ability of the fitting to comply with the no leakage and no blow-off requirement of the specification after the low temperature operation.

Vibration Tests

A vibration test sequence next proves the serviceability of the fitting under this common mechanical condition. Tubing lengths, straight to plus or minus .002 in, are assembled to the fitting at minimum torque. Tubing lengths and displacements to be used have not as yet been established under Specification AN-F-47, but this is not important since the test is only comparing the qualifying fitting to the AN standard. It is only necessary to choose a displacement and length combination for the AN assembly which will put the tubing under sufficient stress to cause failure in a reasonable length of time.

A displacement and length combination for the qualifying fitting is then chosen as close to that used on the AN as is possible, being sure to keep the stress in the tubing the same as the tubing in the AN or control assembly. Experience has shown that, stress of about one-third of the ultimate stress of the tubing material will usually cause failure of the AN fitting assembly between one million and five million cycles.

The vibration machine used in this test is so designed that tube assemblies with fittings on each end are rigidly mounted at each end, one end being free to travel in a longitudinal direction, allowing internal fluid pressure to tend to blow the fitting off the tube as well as eliminating variable pre-stressing of the tube when the test assemblies are

mounted in the machine. Provisions are made for adjusting the amount of displacement of one of the ends from the axial center-line through the fitting and tubing but still maintaining the axes of both fittings parallel, thus producing an "S" bend in the tube. The machine is designed to rotate the displaced end in a plane normal to and in a path concentric with the axis through the fixed end. The stress around the circumference of the test assembly is thus reversed at a speed of 1750, plus or minus 50 rpm, with rotation in the direction tending to loosen the fitting nut at the fixed end. Impulse pressures from 0 psi to 3000 psi and back to 0 psi are simultaneously applied through the fixed end at the same rate and with the same initial surge variations as are used in the impulse test described.

Five specimen assemblies at minimum torque in each size range are tested as described above until they

(Continued on page 27)

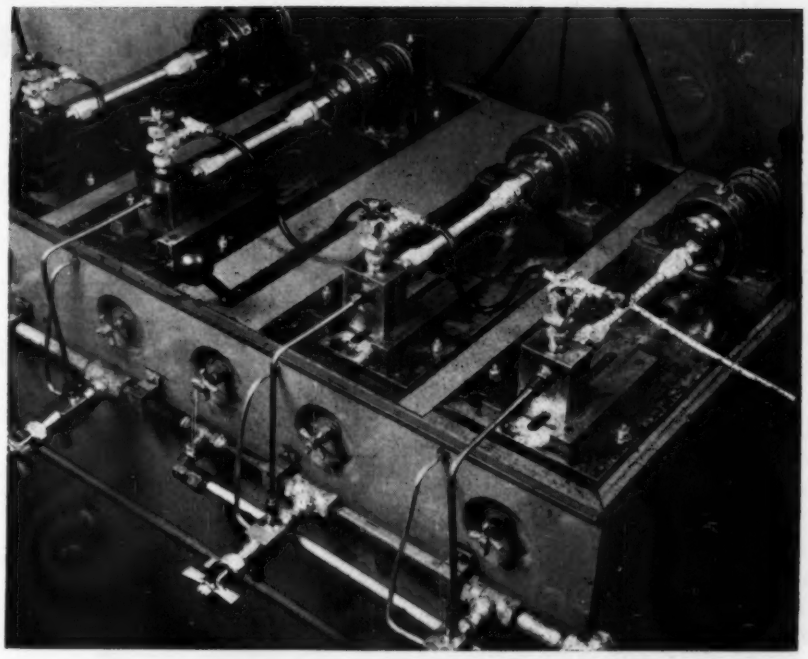
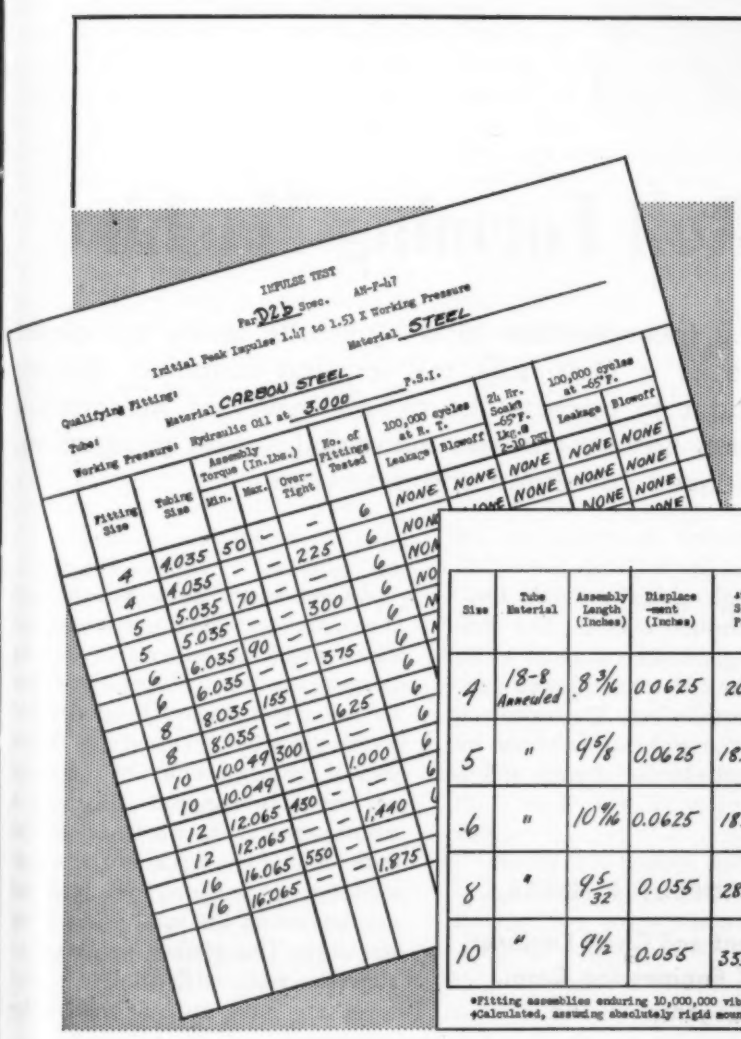


Fig. 2. The vibration test stand compares life of AN and qualifying fittings side by side, using a frequency of 1750 rpm and a deflection calculated to cause failure after from one to ten million cycles. Impulse surge pressures are applied simultaneously at 35 cycles per minute.



IMPULSE TEST

Per D2b spec. AN-F-47

Initial Peak Impulse 1.47 to 1.53 X Working Pressure

Material STEEL

Qualifying Fitting: Material CARBON STEEL

Tube: Working Pressure: Hydraulic Oil at 3,000 P.S.I.

Fitting Size	Tubing Size	Assembly Torque (In.Lbs.) Min.	Max.	Over-Tight	No. of Fittings Tested	100,000 cycles at R. T. Leakage	Blowoff	24 Hr. Soak @ -65°F. 1 Kc. @ 2-10 KC Leakage	Blowoff	100,000 cycles at -65°F. Leakage	Blowoff
4	4.035	50	–	–	225	6	NONE	NONE	NONE	NONE	NONE
4	4.055	–	–	–	–	6	NONE	NONE	NONE	NONE	NONE
5	5.035	70	–	–	300	6	NONE	NONE	NONE	NONE	NONE
5	5.035	–	–	–	–	6	NONE	NONE	NONE	NONE	NONE
6	6.035	90	–	–	375	6	NONE	NONE	NONE	NONE	NONE
6	6.035	–	–	–	–	6	NONE	NONE	NONE	NONE	NONE
8	8.035	155	–	–	625	6	NONE	NONE	NONE	NONE	NONE
8	8.035	–	–	–	–	6	NONE	NONE	NONE	NONE	NONE
10	10.049	300	–	–	1.000	6	NONE	NONE	NONE	NONE	NONE
10	10.049	–	–	–	–	6	NONE	NONE	NONE	NONE	NONE
12	12.065	450	–	–	1.440	6	NONE	NONE	NONE	NONE	NONE
12	12.065	–	–	–	–	6	NONE	NONE	NONE	NONE	NONE
16	16.065	550	–	–	1.875	6	NONE	NONE	NONE	NONE	NONE
16	16.065	–	–	–	–	6	NONE	NONE	NONE	NONE	NONE

Fig. 3. Typical fitting impulse test report for J.I.C. qualification. Specimens assembled under various torque conditions must show no malfunctions at normal or low temperatures.

Fig. 4. Typical vibration-impulse test results show the characteristics of AN aeronautical fittings which must be met or surpassed by industrial fittings for J.I.C. qualification.

IMPULSE VIBRATION TEST DATA

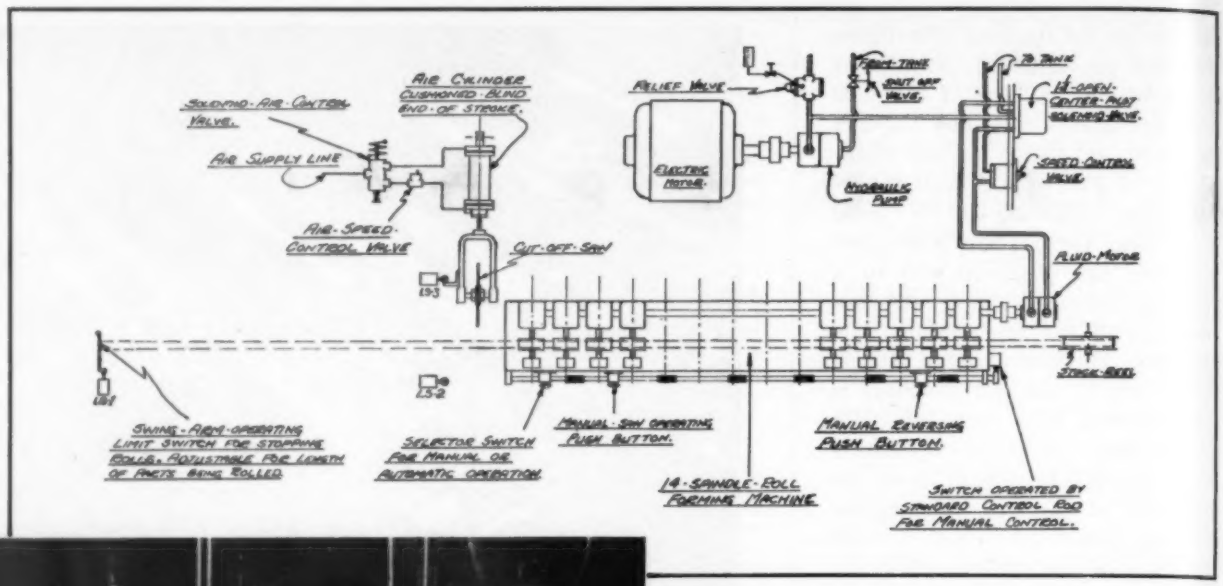
"S" BEND TYPE LOADING

PAR. D-2d-AN-F-47

Size	Tube Material	Assembly Length (Inches)	Displacement (Inches)	*Tube Stress P.S.I.	Vibration Endurance: Average (Cycles) AN	Average (Cycles) Qualifying Fitting	Minimum (Cycles) AN	Minimum (Cycles) Qualifying Fitting	Number of Failures: AN	Remarks	Qualifying Fitting	Remarks
4	18-8 Annealed	8 3/16	0.0625	20,500	966,018	1,012,231	553,500	571,150	5 OUT OF 5	TUBE CRACKED AT BASE OF FLARE ON TAILSTOCK END	5 OUT OF 5	TUBE CRACKED AT BASE OF FLARE ON TAILSTOCK END
5	"	9 5/8	0.0625	18,500	1,442,445	1,504,540	1,203,120	1,287,810	4 OUT OF 4	"	4 OUT OF 5	"
-6	"	10 9/16	0.0625	18,500	7,576,464	7,498,973	3,536,500	3,511,000	5 OUT OF 5	"	3 OUT OF 5	"
8	"	9 5/32	0.055	28,500	2,676,310	2,816,050	644,400	738,525	5 OUT OF 5	"	5 OUT OF 5	"
10	"	9 1/2	0.055	33,500	4,487,888	4,541,685	819,000	905,400	4 OUT OF 5	"	4 OUT OF 5	"

*Fitting assemblies enduring 10,000,000 vibration cycles were removed from vibration machine.

†Calculated, assuming absolutely rigid mounting at both ends of test assembly.


Air Cylinder Cushioned Blind End of Stroke
Solenoid-Air Control Valve
Air Supply Line
Air-Speed Control Valve
Cut-off Saw
Relief Valve
Electric Motor
Hydraulic Pump
Speed Control Valve
Fluid Motor
Swing-Arm-operating limit switch for stopping rolls, adjustable for length of parts being rolled
Selector Switch for Manual or Automatic Operation
Manual Saw Operating Push Button
Manual Reversing Push Button
14-Spindle Roll Forming Machine
Switch operated by standard control rod for manual control

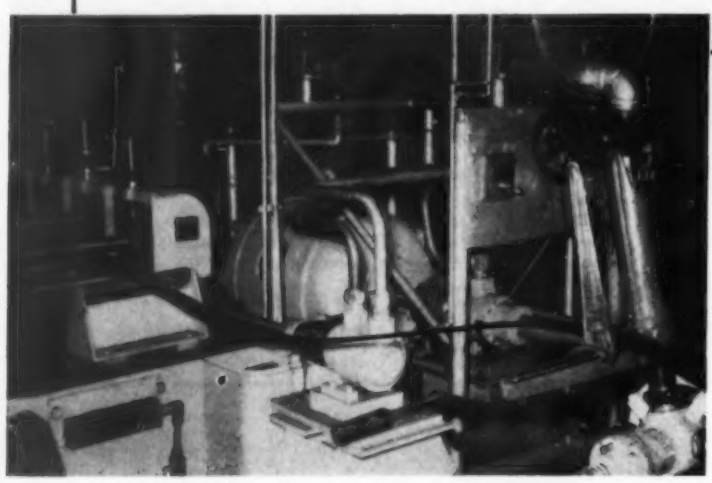


Fig. 1. The drive end of the roll forming machine, showing electric motor, vane pump, direct fluid motor drive, dial type speed control valve (on side panel) and overhead reservoir. The material is shown moving from the stock reel, past the fluid motor to the spindles.

Fig. 2. Schematic of general arrangement of machine and components of the air and hydraulic circuit.

Fluid Drive for Roll Forming Machine

The incorporation of a hydraulic motor for direct drive of a 14-spindle roll forming machine, an air cylinder to operate the cut-off saw and the control circuits have increased accessibility and production, decreased downtime and maintenance.

OUR CUSTOMER, A MANUFACturer of rolled carbon and stainless steel tubing and of a large variety of rolled shapes for automotive window frames and other mouldings, had purchased a large fourteen spindle roll forming machine. A retractable metal saw, for reasons to be explained, was specified. The original specifications for V-belt drive, brake and friction clutch were abandoned in favor of a hydraulic motor, direct-coupled to the main drive shaft, an air cylinder to operate the cut-off saw and control through a fairly simple interlocking electric circuit. The fluid drive has given the customer an extremely flexible, versatile and satisfactory installation. The details of the layout and operation of the hydraulic and electric circuits will be described.

By RUPERT P. ESSER,

President and Chief Engineer, TEC Engineering Corp., Logansport, Ind.

An important factor was the fact that a number of the runs were quite short, requiring rather frequent set ups, occasionally several times per day. For this reason, it was decided not to use a flying cut-off due to the cost of the many different shapes of cut-off tools required. Instead, a metal saw was installed next to the outlet end of the machine and an air cylinder was provided for advancing and retracting the saw to and from the stock. This made it necessary to stop the rolls while the saw was traveling. The machine had orig-

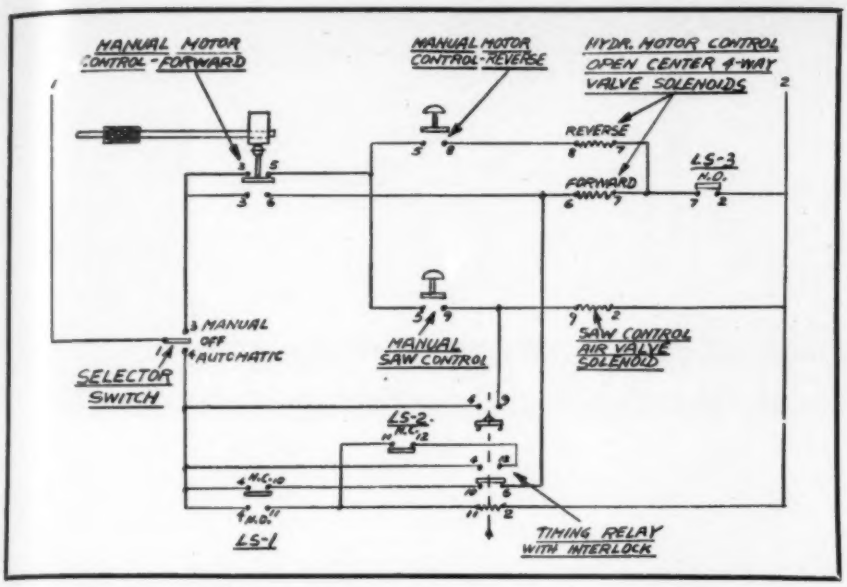


Fig. 3. Electric control circuit diagram of the hydraulic drive of the roll forming machine.

inally been designed for a V-belt drive from a 40 hp, four speed electric motor. A limit switch, operated by a small swing arm (Figure 2) contacted by the material being rolled, was provided for stopping the rolls prior to sawing. The motor was then restarted by another limit switch contacted by the saw frame in the rest position. However, it was not possible to cut uniform lengths due to coasting of the rolls caused by the inertia of the large motor rotor.

Neither a magnetic brake nor a plugging switch arrangement was acceptable because of complications of the electric circuit and the very frequent high starting inrush current on the electric motor. A mechanical friction clutch operated by an air cylinder was eliminated because of space requirements and the maintenance problems involved.

A hydraulic motor appeared to be the logical answer, particularly since infinite speed variations are easily obtained from a hydraulic drive. A double pilot solenoid valve, which when deenergized, by-passes the flow from the pump, was provided. This also permits reversing of the rolls, a feature which has proven exceptionally valuable during set ups or when trying out new forming tools. The travel speed of the main valve spool was adjusted so that the rolls would stop quickly without any appreciable coasting and without objectionable shock in the lines. A dial type flow control valve, together with the different available pump motor speeds, gave positive control of the hydraulic motor speed over a very wide range.

The arrangement of the air and hydraulic circuit is shown in the general arrangement drawing, Figure 2. The vane type pump with large end suction capable of delivering 55 gpm at pressures up to 1500 psi, is direct coupled to the 1150 rpm electric motor. The vane type fluid motor selected is rated at 180 lb-in per 100 psi operating pressure, theoretical torque, which would require 55 gpm for 1000 rpm speed and 1200 psi for an output of 30 hp at 1000 rpm. A safety relief valve, adjustable from 500 to 1500 psi, equipped with a pressure gauge, was also provided. During a period of over 6 months operation the working pressure has never exceeded 900 psi, approximately equal to 20 hp at 1000 rpm.

Provision was made for both manual and automatic operation. A selector switch may be placed in "off," "manual" or "automatic" position. For manual operation two motor controls, one forward, one reverse, are provided and a manual switch to operate the saw. The fluid motor is controlled by a pilot solenoid hydraulic valve and the movement of the cut-off saw by a solenoid air valve.

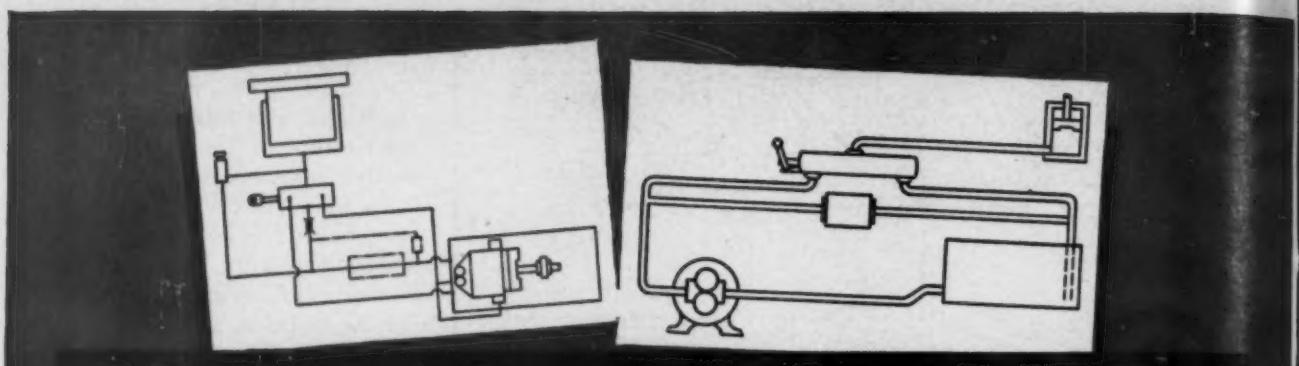
The electric control circuit is basically simple (Figure 3). The swing arm of LS-1, when contacted by the material being formed stops the rolls through the timing relay. The position of LS-1 is adjustable to provide for variations in length of parts being rolled. Limit switches LS-2 and LS-3, which are contacted in the forward and return positions of the saw, a selector switch, mushroom head push buttons for manual control of the saw and manual reverse operation of the hydraulic motor, a switch operated by a control rod along the full length of the machine, a timing relay with interlock contacts and the solenoids of the hydraulic and air valves complete the electrical circuit.

When the selector switch is placed in the "manual" position, the rolls can be run forward by operating the control rod in front of the machine. The saw can be operated by depressing the manual saw button, or the rolls can be run in the reverse direction by depressing the reverse button. These switches are so interlocked that the saw cannot be operated or the reverse solenoid energized when the forward switch is closed through the control rod.

When the selector switch is put in the "automatic" position, the rolls will run in the forward direction until the formed material leaving the machine contacts LS-1. This energizes the timer relay coil, cutting the circuit to the forward solenoid and causing the hydraulic motor to stop. Pump delivery is then by-passed through the open center valve back to the tank at no pressure. After a very short but adjustable time delay, sufficient to insure that the rolls have completely stopped, the timer energizes the saw control air valve solenoid, causing the air cylinder to move the saw outward, cutting off the material. At the end of the saw travel, a projection on the saw frame contacts LS-2, breaking the holding circuit for the timer coil and causing the timer to drop out. This deenergizes the saw control air valve solenoid, returning the saw to its starting position and making the circuit to the forward hydraulic valve solenoid. This solenoid will not be energized and the hydraulic motor cannot start until the saw has returned to its rest or starting position and has contacted LS-3, completing the circuit to the forward valve solenoid.

This cycle is repeated automatically until the selector switch is

(Continued on page 27)



A Beginner's Course in Basic Hydraulics

Chapter IV

PIPES, FITTINGS AND SEALS

Materials, sizes and thicknesses of pipe; friction and screwed fittings.

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Pipes

MATERIALS USED. FROM EARLY times pipes were employed to convey water from one place to another. In ancient times water supply systems were crude, e.g., pipes were made by binding four wooden slabs together in the general form of a square. These and other primitive forms of piping gave fairly satisfactory service, since the pressures were relatively low. With higher pressures, however, stronger materials became indispensable.

The first metal piping was crudely made from wrought iron, which contained very little carbon, a substance which makes iron brittle. Wrought iron is easier to work than steel with its larger carbon content, or than cast iron, which contains still greater quantities of carbon.

Wrought iron is still used for piping, since it is nearly as resistant to corrosion by acids as copper, which is, of course, a highly acid resistant metal. In addition, wrought iron is much cheaper than copper. Pipes and tubing are now also made from cast iron, steel, copper, brass, tin, lead, aluminum, concrete and other materials. Piping is used for a great many fluids and pressures. For oil and compressed air transmission lines practically all piping and tubing is made of steel, copper and brass.*

Steel pipe is relatively inexpensive and is extensively used because of its strength, its suitability for bending and flanging and its adaptability to high pressures and temperatures. Its chief disadvantage is its comparatively low resistance to corrosion.

Copper piping and tubing is sometimes used on high-pressure lines*, but is unsatisfactory for high temperatures or if subjected to repeated stresses, since it has a tendency to harden and break under these conditions. For example, at 360 F, the resisting strength of a copper tube is reduced about 15 percent. However, copper can easily be drawn or bent.

Piping made of brass, an alloy of copper and zinc, is sometimes used instead of copper where the maximum working pressure is under 250 psi. Brass is very resistant to corrosion, but cannot be bent as easily as copper. Brass piping is usually employed in low pressure systems where threaded connections can be used, e.g., in drain or lubricating lines.

Fig. 48. Cross sections of butt-welded and lap-welded pipe.

* *It is important that the student be familiar with Section H4, "Piping, Fittings and Fluid Passages" of J. I. C. Hydraulics Standards for Industrial Equipment.*

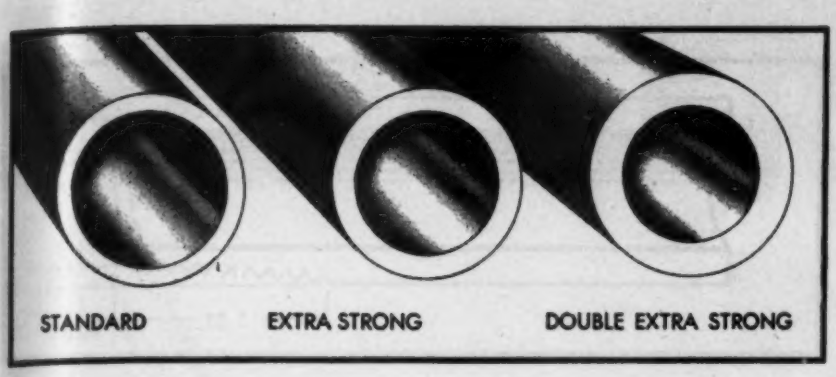


Fig. 49. The relative wall thicknesses in a single size of pipe. Sizes must be selected to take care of maximum expected working pressures and maximum volume of flow at moderate velocities.

Methods of manufacture. Pipes and tubes can be either butt-welded or lap-welded, as show in Figure 48, or hot metal bars can be pierced, drawn out and rolled into seamless pipe. Copper pipe comes either seamless or welded, while brass pipe is almost invariably seamless.

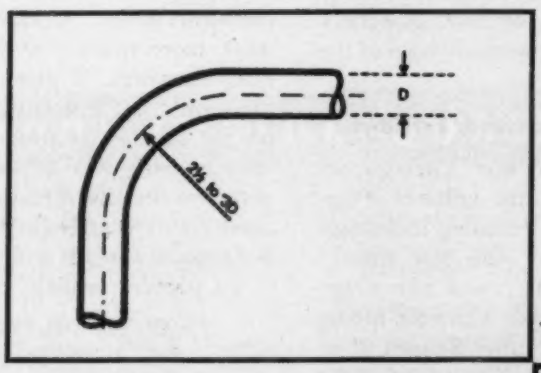
Size and thickness. Pipes are made with walls of three thicknesses—standard, extra strong and double extra strong (see Figure 49). The extra thickness indicated by these terms depends on the size of the pipe. Standard thickness pipes up to 12 inches in diameter are referred to by an indicated or nominal inside diameter, but actual inside diameters vary considerably from the indicated figures. The situation is further complicated by the fact that extra strong and double extra strong pipes have the same outside diameters as standard pipes of the same indicated size. The walls are made thicker at the expense of the inside diameter. Above 12 inches, pipes are designated by outside diameter, as is the case also with copper and bronze tubing of all sizes. Pipe is sometimes described in terms of its actual outside diameter and its thickness, e.g., 6⅝ in OD x 0.28 in wall.

Choice of materials and sizes. The demands that a hydraulic system must satisfy are often varied and complex, so that many different kinds of pipe, tubes and fittings must enter into consideration in designing an installation. The material to be used depends on the particular situation. Steel is employed where strength is required, or where high temperatures will be encountered. Copper or brass, depending on the fluid carried, can be used where operating temperatures are below 350 F. These metals are less liable to corrosion and offer less resistance to flow. However, steel stands up better under vibration.

The maximum working pressure governs the material and the pipe thickness to be used. Where resistance to high pressures is a primary consideration, seamless steel piping should be used. If the strength of a given steel pipe is taken as 100, a lap-welded pipe of the same size will have a strength of about 92, and a butt-welded pipe a strength of about 73. Standard thickness 1-inch copper tubing will take pressures of over 1000 psi, while 2-inch tubes will take over 800 psi. For greater pressures, thicker tubes or pipes must be used.

The volume of flow to be carried determines the size of pipe to be used. Pipes should be large enough to conduct the maximum volume of flow at a moderate velocity, so that losses due to friction will not be excessive. Velocities of five feet per second are common.

Minimizing friction. The units of a hydraulic system are designed as compactly as is practicable, in order to keep the connecting lines short. Every section of pipe should be anchored securely in one or more places so that neither the weight of the piping nor the effects of vibration is carried on the joints. The aim should be to minimize stress throughout.



Deviations to sharper or gentler curves increase pressure loss or turbulence.

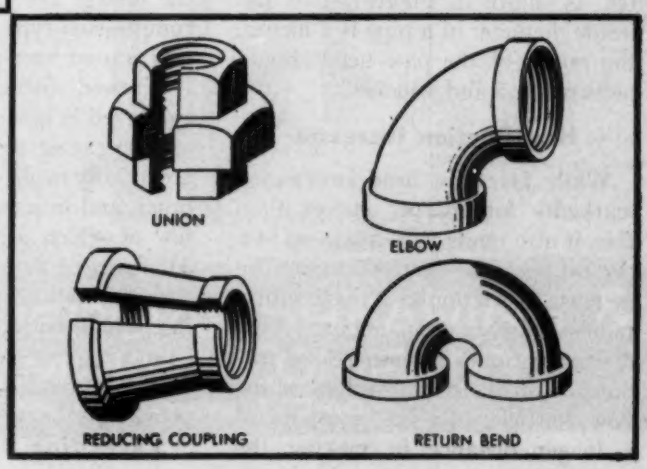


Fig. 51. Typical screwed fittings for low pressure applications.

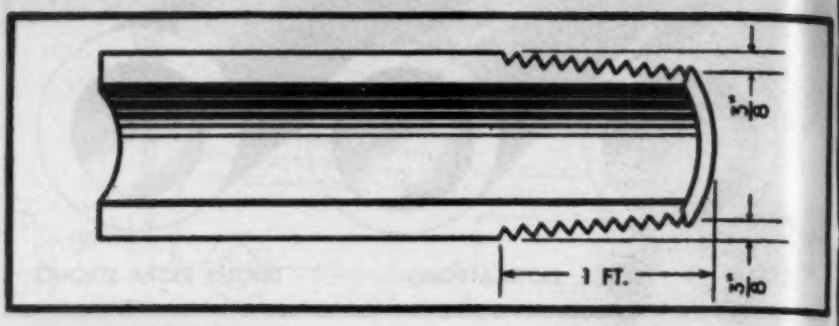


Fig. 52. Standard pipe thread taper is designed to insure tight connections.

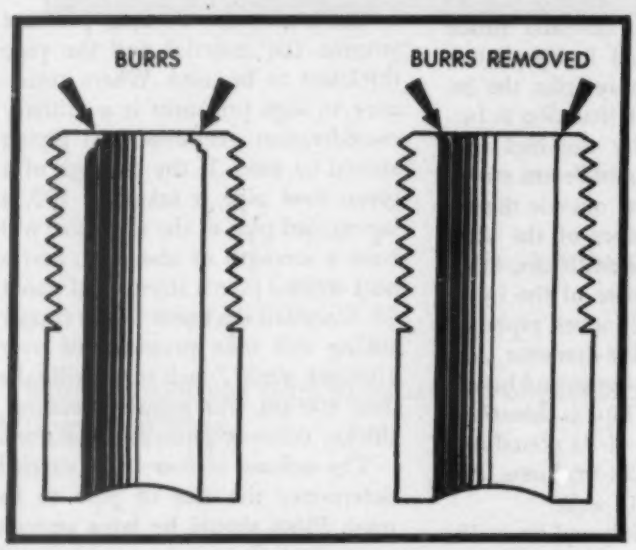


Fig. 53. Sharp edges or burrs, if not removed, obstruct fluid flow; if metal particles detach into the line, they may cause serious damage.

It often becomes necessary to introduce bends in the piping of a hydraulic system in order to reduce the number of joints or avoid obstructions that would otherwise require the use of several pieces of pipe and fittings. At the same time, however, bends should be avoided where possible.

We have already pointed out that bends are described in terms of the ratio of the radius of the bend to the inside diameter of the pipe. The best radius for a pipe bend is between 2.5 and 3.0 times the inside pipe diameter, as shown in Figure 50. If the inside diameter of a pipe is 2 inches, the radius of the pipe bend should be between 5 and 6 inches.

How Friction Increases

While friction head increases markedly for sharper curves than this, it also tends to increase up to a certain point for gentler curves. The increase in friction in a bend with a radius of more than about 3 pipe diameters comes from increased turbulence on the outside edges of the flow. Particles of a fluid must travel a longer distance in making the change in direction. When the radius of the bend is less than about 2.5 pipe diameters, the increased pressure loss is due to the abrupt change in the direction of flow, especially for particles on the inside edge of the flow.

Fittings: Screwed Fittings

Varieties and use. Fittings are used to connect the units of a hydraulic system, including individual sections of pipe. The pipe fittings most commonly used are either screwed or flanged, while for tubing the fittings are either flanged or of compression type. Either kind of fitting is used for a particular purpose.

Screwed fittings are commonly employed in low pressure pipes such as lubricating or drain lines. They are usually made of steel, copper and brass, and in a variety of designs, a few of which are shown in Figure 51. Screwed fittings are made with standard female threading—threading, that is cut on the inside surface—and require that the end of the pipe be threaded with outside male threads for connecting.

Threading pipe. The threads should be cut clean and smooth. The dies and pipe cutting tools should be sharp so that they will not drag metal. Otherwise, threads will fit poorly, and leakage may result. Use oil liberally when cutting threads. Standard pipe threads are tapered slightly to insure tight connections. The amount of taper is about ¾ inch in diameter per foot of thread (Figure 52).

After pipe has been cut or threaded, the ends should be inspected for burrs. All projections and sharp edges, inside and out, should be removed (Figure 53). If this is not done, they will obstruct the flow of liquid, and loose particles of metal may get into the pipe line and cause damage.

Metal is removed when a pipe is threaded, thinning the pipe and exposing new and rough surfaces for chemical action. Corrosive agents work more quickly at such points than elsewhere. If pipes are assembled with no protective compound on the threads, corrosion sets in at once and the two sections stick together so that the threads seize when disassembly is attempted. The result is damaged threads and pipes.

To prevent seizing, permatex or

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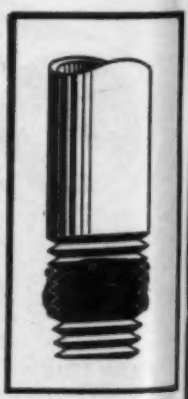

Fig. 54. The proper applications of "pipe dope" on male fittings prevents seizing and protects the system from unnecessary damage.

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Recommended operating pressure standard cylinders 1500 P.S.I.

Specially designed cylinders can be furnished for operating pressure 6500 P.S.I.

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  - Single Acting
  - Double Acting
- **END CONNECTIONS FOR MOUNTING—**
  - (Top) Plain or Pin Eye
  - (Bottom) Plain, Pin Eye, Trunion or Universal
- **FEATURES—**

Design—Over twenty years of experience has developed and proved the "complete line" which covers a size range, both bore and stroke, that will satisfy most any application.

Production Technique—Finest materials obtainable are fashioned to close tolerances with high degree of finish. Skilled craftsmen operate finest modern machines equipped with the best tools.

Testing—Each individual cylinder must meet rigid pressure and performance tests before it can obtain the "Commercial" stamp of approval.

"Commercial" Hydraulic Cylinders Are A Quality Product

LOOK INSIDE—QUALITY IN EVERY STROKE

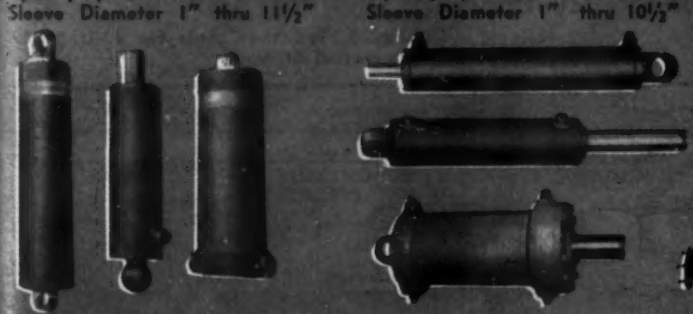
SINGLE SLEEVE CYLINDERS

Single Acting (Load Return)

Capacity up to 50 tons. Effective Sleeve Diameter 1" thru 11½"

Double Acting (Power Return)

Capacity up to 40 tons. Effective Sleeve Diameter 1" thru 10½"



(Capacity based on 1000 P.S.I. rating.)

MULTIPLE SLEEVE CYLINDERS

(TELESCOPIC)

TWIN CYLINDER (LOAD RETURN)

Capacity up to 50 tons

Effective Sleeve Diameter 1¾" thru 11½"

SINGLE CYLINDER (LOAD RETURN)

Capacity up to 40 tons

Effective Sleeve Diameter 1¾" thru 7⅞"

WORLD'S LARGEST PRODUCER OF TELESCOPIC CYLINDERS

QUALITY IN EVERY TURN

The COMMERCIAL SHEARING & STAMPING COMPANY

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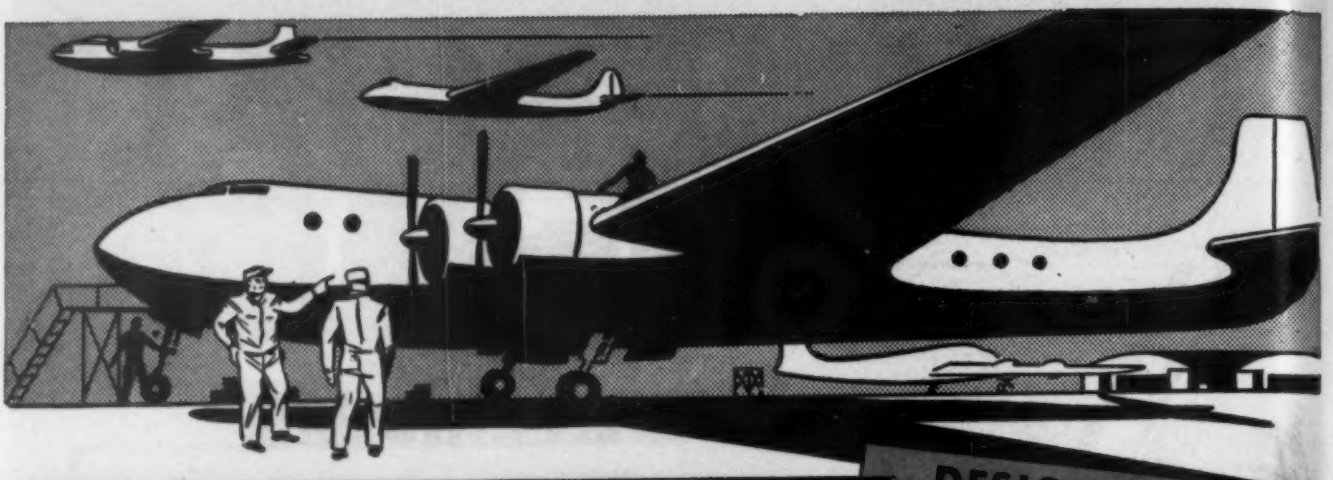


AVIATION HYDRAULICS

DESIGN
OPERATION
MAINTENANCE

FRED O. HOSTERMAN
Advisory Editor

Development of High Pressure Seals for AN Straight Thread Fittings

By H. E. CORNISH
and J. C. BLOOM

Douglas Aircraft Company, Inc.
El Segundo Plant

Introduction—AND 10050 Boss Seal Failures on Service Aircraft

THE AD SERIES AIRCRAFT WERE the first production airplanes at the Douglas El Segundo Plant, to use 3000 psi hydraulic systems. Straight threaded AND 10050 port bosses were provided at all unit ports. This was the first time that this port configuration was exclusively used in a production 3000 psi hydraulic system. Experience, both on airplanes with 1000 and 1500 psi systems and with random tolerance laboratory tests at 3000 psi, had demonstrated the AND 10057 "universal" elbow and tee type fittings, illustrated in Figure 1, to be unsatisfactory. As a result, units were designed or mounted such that all high pressure ports could use the AND 10056 straight type fitting illustrated in Figure 2. This necessitated careful advance planning of plumbing runs at the time the hydraulic units were being designed.

Random tolerance laboratory tests of the AND 10056 integral nut type fitting illustrated in Figure 2 indicated that it should be satisfactory if used with an AN6227 "O" ring gasket. AN6227 toroidal "O" rings were used in lieu of the AN902 square cross-section gasket originally established as the standard

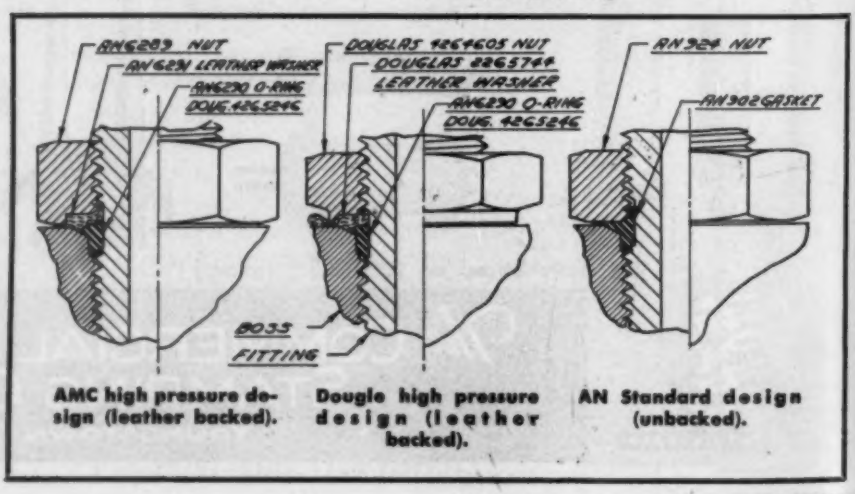


Fig. 1. Types of seals for AND 10057 universal fitting.

AMC high pressure design (leather backed). | Douglo high pressure design (leather backed). | AN Standard design (unbacked).

seal for AND 10050 boss connections. The Air Force had provided substitute AN6227 gaskets for the AN902 apparently because of difficulties with the AN902. These gaskets are illustrated Figure 3. Shortly after the AD airplanes were placed in service, reports of frequent leakage at the boss connections were received. There was considerable concern because of the large-volume of gasket material that extruded from under some of the fittings during assembly.

Development and Test of Satisfactory Gaskets for Straight Fittings

An investigation of the above difficulties was initiated in June, 1946. At the outset it was thought that for a gasket seal to be satisfactory, it should be completely contained in the boss cavity such that metal to metal contact between the fitting and boss surface would be obtained under all tolerance conditions.

A study made of the volumetric relationship of the gasket and the sealing cavity revealed that both the AN902 and AN6227 substitute gasket volumes greatly exceeded the boss and fitting seal cavity volume. This was in direct disagreement with the contained gasket concept. Further, AN902 and AN6227 demonstrated no uniform relationship of gasket volume divided by cavity volume considering minimum and maximum tolerances of boss, fitting, and gasket in the different line sizes. It became obvious that if the boss gasket was to be contained within the cavity under all conditions a new series of gaskets had to be designed for the specific purpose of sealing the AND 10050 boss. See Figure 4 for volume data.

The more costly molded "O" ring shape was selected for this design because of the close tolerance control obtainable with molded parts as compared to the AN902 type of cut gasket. Also, it was believed that a gasket with a round section would be better suited to the "jam" gasket application, being of a more stable shape and requiring less deformation during assembly.

An "O" ring shape was established that required a small amount of stretch when installed on the fitting relief diameter. This was done to hold the gasket in place during start of installation. Maximum occupation (max. volume gasket in minimum volume cavity) was set at 100 percent. Figure 2 shows the volumetric relation, to scale, of seal to cavity, for the AN6227 "O" ring and the new "O" ring in the —5 tube size connection, at maximum cavity occupation. Minimum occupation was established by existing fitting and "O" ring tolerances. Minimum occupation was from 52 percent in the —3 (3/16 tube) size to 72 percent in the —12 (¾ tube) size. Minimum occupation in the —4 size was 59 percent. As explained later, tests proved that this percentage occupation was satisfactory with the final gasket. Despite concern regarding minimum occupation it was considered necessary that the new gasket be satisfactory with fittings and bosses already in service. For this reason fitting or boss dimensions could not be changed. Also, the AN6227 "O"-ring tolerances were considered to be as small as practicable. Therefore, existing boss and fitting dimensions and existing "O" ring tolerances were used in design of the new gasket.

It was believed that for tests of gaskets to be meaningful, the test part tolerances should be controlled. Special boring tools were made to hold boss dimensions to the desired extreme within a fraction of the normal tolerance. The volume of individual "O"-rings was determined by weight. Fittings were machined to special dimensions. Parts were then selected to give the desired adverse tolerance volumetric relationship. The actual measured volumetric occupation of the gasket in each cavity was recorded.

Since test results obtained from single specimens are not always conclusive, six to twelve gaskets in each size were tested. During installation

Fig. 2. Old and new gasket seals showing maximum occupation condition.

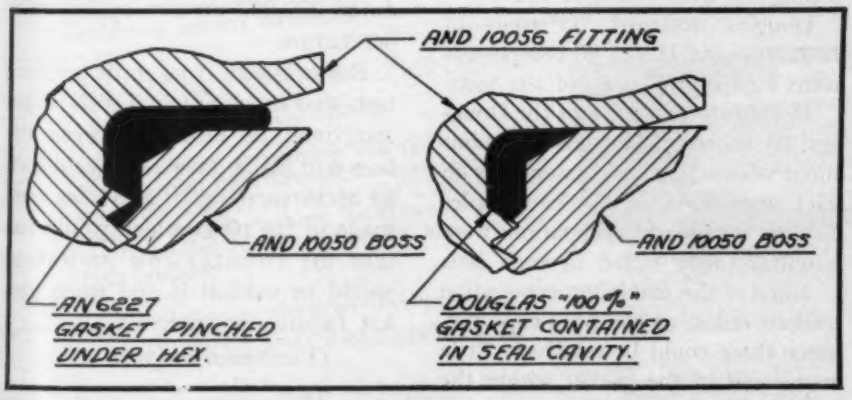
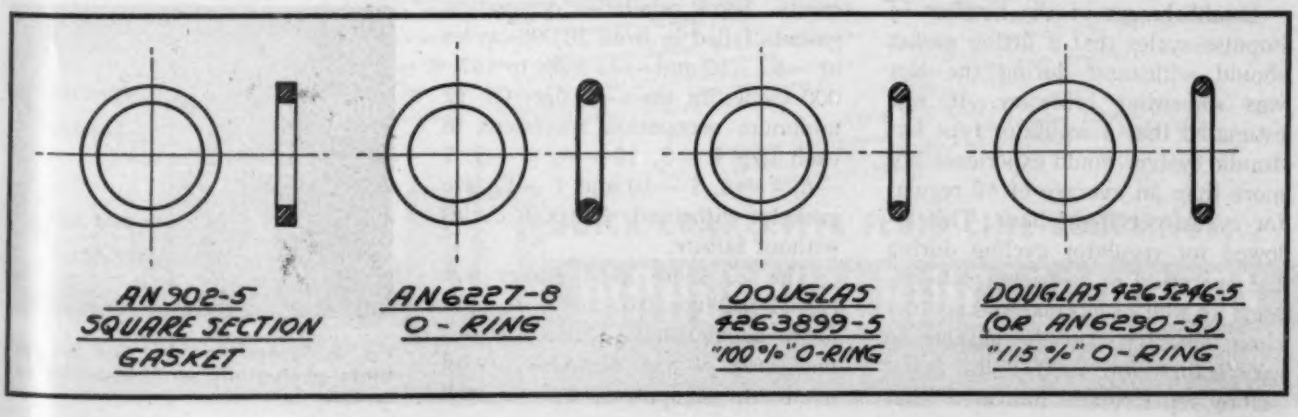

AND 10056 FITTING
AND 10050 BOSS
AND 10050 BOSS
AN6227 GASKET PINCHED UNDER HEX.
DOUGLAS "100%" GASKET CONTAINED IN SEAL CAVITY.

Fig. 3. The various synthetic rubber seals which have been used for the 5/16 in tube size fitting, showing the relative sizes.



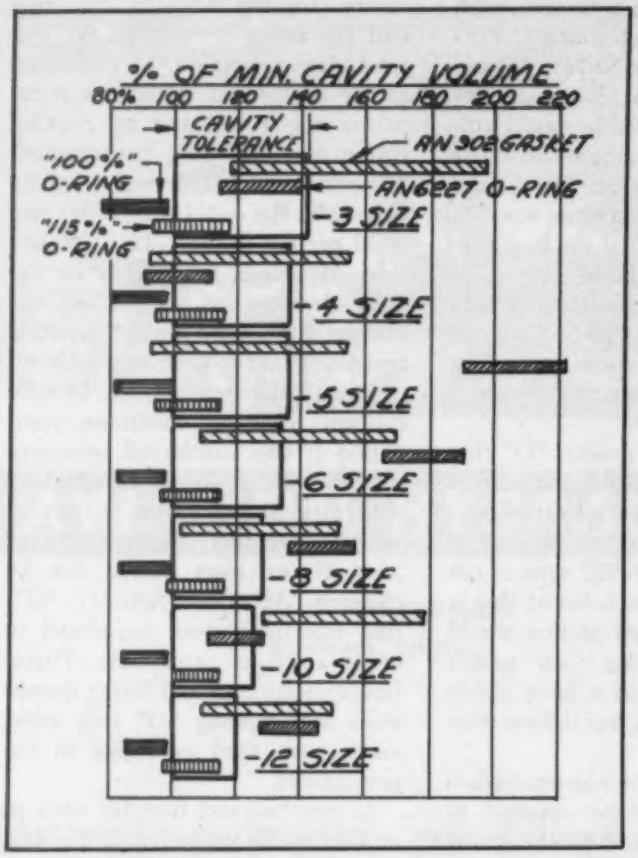


Fig. 4. Volume tolerance comparisons showing cavity volume and the volume of the AN902 gasket, and AN6227, 100 percent and 115 percent "O" rings for each size, expressed as percent of minimum cavity volume. The narrow bars show the variation in gasket volume from minimum to maximum as allowed by dimensional tolerances. The wide unshaded bar in each size shows the variation in cavity space from minimum to maximum tolerance.

of test parts into the manifold blocks fittings torques were controlled.

Testing of the gaskets was accomplished by repeated rapid application of hydraulic pressure. The base pressure applied was 3000 psi with impulse peak pressure controlled at 4500 psi, considered to be a realistic value. Rate of pressure rise during the impulse test was not controlled. However, rate of pressure rise was measured to be in the order of 450,000 psi/sec during the majority of the testing. The pressure phenomena was measured and recorded photographically, by use of an oscilloscope and suitable strain gage pressure pick-ups. A reproduction of one of the pressure time histories is shown in Figure 5.

Establishment of the number of impulse cycles that a fitting gasket should withstand during the test was somewhat arbitrary. It was estimated that a regulator type hydraulic system would experience not more than an average of 40 regulator cycles per flight hour. This allowed for regulator cycling during the operation of restricted sub-systems as well as normal leakage cycling. Desiring that the gaskets be satisfactory for 5000 flight hours before replacement indicated that 200,000 impulse cycles should be applied during the test. The use of 4500 psi pressure peaks provided failure of inferior parts within a reasonably short time of impulse testing.

Temperature of the hydraulic oil during the tests averaged 120 F.

Douglas designed "O"-rings of H-212-70 and H-201-90 compounds were used during most of the tests.

During the first tests of the Douglas 70 shore gaskets twelve minimum occupation seal assemblies in each size were used. Six samples having maximum occupation were simultaneously tested in each size.

None of the maximum occupation gaskets failed, as had been expected, since there could be relatively little movement of the gasket within the cavity. Some minimum occupation gaskets failed in from 20,000 cycles in —8, —10 and —12 sizes to 147,000 cycles in the —3 size. Of 12 minimum occupation specimens in each size 9 —3, 12 —4, 8 —5, 7 —6, 4 —8, 5 —10 and 7 —12 size gaskets withstand 200,000 cycles without failure.

The 70 shore hard gasket was considered unsatisfactory in light of the above results. During the second series of tests six AN902 with maximum occupation, and six each Douglas 70 shore, and Douglas 90 shore gaskets with minimum occupation were tested simultaneously for each line size. The AN902 gaskets were tested in order to establish a basis for judging relative performance of the new parts. The 90 shore Douglas gaskets were tried in an effort to reduce the effect of chafing of the "O"-ring on the sharp corner at the juncture of the countersink and counterbore of the AND 10050 boss when the minimum occupation gaskets moved within the cavity during application of impulse pressure.

Thirteen very early failures of the AN902 gaskets occurred in the —10 size, 5 in less than 1600 cycles. During testing, failed gaskets were replaced. One early AN902 failure occurred in the —12 size and one in the —3 size. These failures were due to gasket damage during assembly combined with extrusion due to impulse pressure. Figure 6 shows the typical condition of an AN902 when removed from a boss after failure.

A considerable number of failures of the Douglas 70 shore "O"-ring gaskets occurred. The earliest of 28 failures was at 1500 cycles. Of 56 test gaskets, 28 withstood 200,000 cycles.

The forty-two 90 shore hard Douglas gaskets successfully endured 200,000 impulse cycles without failure.

It was known from static pressure tests that metal to metal seals would sometimes be formed between the boss and fitting faces. To avoid such an occurrence, radial scratches were made in the plugs which would run into the countersink so leakage would be evident if and when gasket failure occurred.

(Continued on page 22)

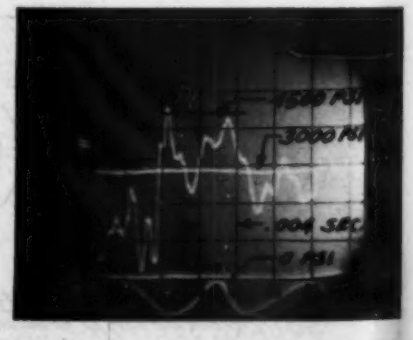
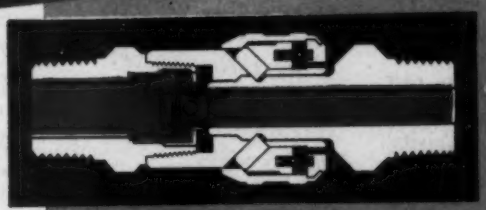


Fig. 5. Typical impulse test pressure surge photograph on the oscilloscope screen.

Save ✔TIME ✔TROUBLE ✔MONEY WITH THESE HANSEN COUPLINGS

HANSEN PUSH-TITE COUPLING
Shuts off one side of line

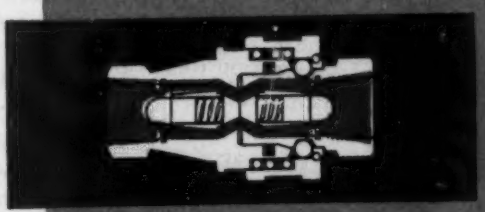
Gives quick connection and disconnection, with instant automatic flow or shut-off. To connect coupling, and open line to flow of fluid, merely push plug into socket. To disconnect, a slight pull on sleeve releases plug and shuts off supply end of line.



PUSH-TITE COUPLING

HANSEN HIGH PRESSURE TWO-WAY SHUT-OFF COUPLING

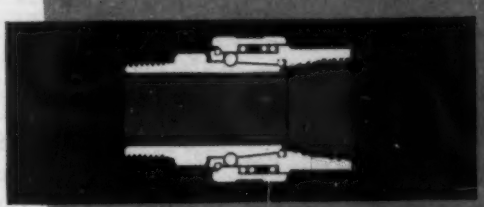
To connect, pull back sleeve and push plug into socket. Identical torpedo type valves permit free flow of gas or liquid through coupling. To disconnect, pull back sleeve . . . coupling immediately disconnects, valves automatically seal both ends of line. Can be mounted to disconnect automatically where fluid lines may be subject to sudden, damaging strain.



Series HP 8000

HANSEN STRAIGHT-THROUGH COUPLING

Provides quick connection and disconnection, but does not have shut-off feature. Size range for general use from ¼" to 2½". Two special types of straight-through steam couplings also available—one for low pressures, and one for high pressures.



Series ST Straight Through Coupling

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Tennessee, Arkansas, Kentucky: Ralph A. Hiller Co., Nashville, Tennessee
Michigan: William .I. Nash Company, Detroit, Michigan
Indiana, Wisconsin: Neff Engineering Co., Ft. Wayne, Indiana, Milwaukee, Wisconsin
Northern Illinois, Eastern Iowa: Walter Norris Engineering Company, Chicago, Illinois
Central Midwestern States: Sturgis Equipment Co., St. Louis, Missouri
North Midwestern States: Hanscome-Rogness Company, Minneapolis, Minnesota
Texas, Oklahoma: Leo J. Schindler, Dallas, Texas
Colorado, New Mexico, Utah, Wyoming: E. C. Wild Company, Denver, Colorado
Northern California, Nevada: V. E. Lawford, Oakland, California
Arizona, S. California: Chester Paul Company, Glendale, California
Idaho, Oregon, Washington: Jack J. Kolberg Company, Seattle, Washington

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WRITE FOR CATALOG No. 47
giving descriptions and sizes of complete Hansen line of straight through and shut-off couplings for hydraulic and pneumatic connections.

QUICK CONNECTIVE FLUID LINE COUPLINGS...

THE HANSEN MANUFACTURING COMPANY

4031 WEST 150th STREET • CLEVELAND 11, OHIO

HIGH PRESSURE SEALS

(Continued from page 20)

Now that a gasket had been developed that would withstand 200,000 impulse cycles under both maximum and minimum occupation conditions, it was decided to investigate the effect of gap due to lack of boss squareness. Many bosses had been found in hydraulic units and some in fittings that had the boss surface out of square with the thread axis more than the ½ degree allowed by the AND 10050 drawing. This was a reminder that the new gasket should resist extrusion through a gap between the fitting and boss equivalent to at least ½ degree angularity (.0045 in —3 to .012 in —12 size). A shim was installed between the edge of the test plug and the boss to produce a gap equivalent to ½ degree angularity. Six Douglas 90 shore gaskets in bosses providing minimum occupation in each size, were impulsed for over 200,000 cycles. No failures occurred.

It was considered that maximum occupation rings might be damaged by assembly since deformation and friction was greater than with minimum gaskets in maximum cavities that had been tested. Six Douglas 90 shore rings in sizes 3, 4, 5, 6, 8 and 12 were assembled in bosses providing maximum occupation and were subjected to over 200,000 cycles of impulse simultaneously with those in the gap test. No failures occurred.

Having concluded that the new 90 shore O-ring was acceptable for airplane use at normal temperature, tests were made at —65 F. Six 90 shore "O" rings in each size, installed in bosses providing minimum occupation, were subjected to 1000 pressure impulses at —65 F after 3 days of low temperature soak. This was followed by 5800 impulse pressure cycles at normal temperature without failure. This indicated the ring should be satisfactory during extreme low temperature operation.

Service experience with the new 90 shore gasket during the past two years has been highly satisfactory. Several hundred airplanes, each having approximately 150 3000 psi boss connections, are now in service. No failures have been reported.

In a meeting with hydraulic engineers from other aircraft companies it was agreed that the 90 shore gasket should be increased in volume approximately 15 percent. This was agreed upon as a means of increasing gasket occupation of the boss under minimum occupation conditions. The 15 percent excess gasket volume under the maximum boss occupation condition was considered acceptable. It was thought that the excess volume would be accounted for by compression of the gasket, expansion of the boss, and extrusion of the gasket into the fitting threads. Further, on the basis of impulse tests conducted with fitting gap it was decided that a very slight gap between the boss face and the fitting could be tolerated. This change in volume was made despite the fact that the 90 shore ring with a maximum boss occupation of 100 percent passed all laboratory tests at both tolerance extremes without failure of any kind. The final "O" ring dimensions that were proposed to the Services through the S.A.E. Hydraulics Committee A6 were calculated on the basis of 115 percent maximum boss cavity occupation. It is understood that Wright Field conducted further tests with the final configuration prior to its issuance as the AN6290 standard gasket.

Gasket Seal for Free Positioning And 10057 Universal Elbow

As stated above, the use of the universal fitting with a separate jam nut had been avoided, particularly in 3000 psi lines, in the design of the hydraulic units and plumbing on the AD Series Airplanes. This was done because of previous troubles at lower pressures and unsatisfactory 3000 psi laboratory test results. It developed, however, on later airplanes of the AD series that space was limited such as to necessitate the use of a small number of some type of positionable elbow. On the basis of limited test information, an inverted and reworked elastic stop nut, backing up an "O" ring had been used. Numerous leakage failures had occurred, however, and the need for an improved seal in the —4 size became evident.

An AND 10057 universal fitting jam nut with depression for a leather backup washer to be used with a rubber gasket had been designed by the Air Material Command (AMC). The leather was intended to jam the gasket into the boss cavity and prevent extrusion of the gasket from under the nut face as well as through the clearance between the nut and fitting threads. It was understood that impulse testing of this design resulted in failure of the seal. Apparently there was insufficient compression of the leather washer. Some test parts were made at Douglas with a reduced jam nut cavity volume intended to result in more pressure being applied to the leather washer during assembly. When these

(Continued on page 24)

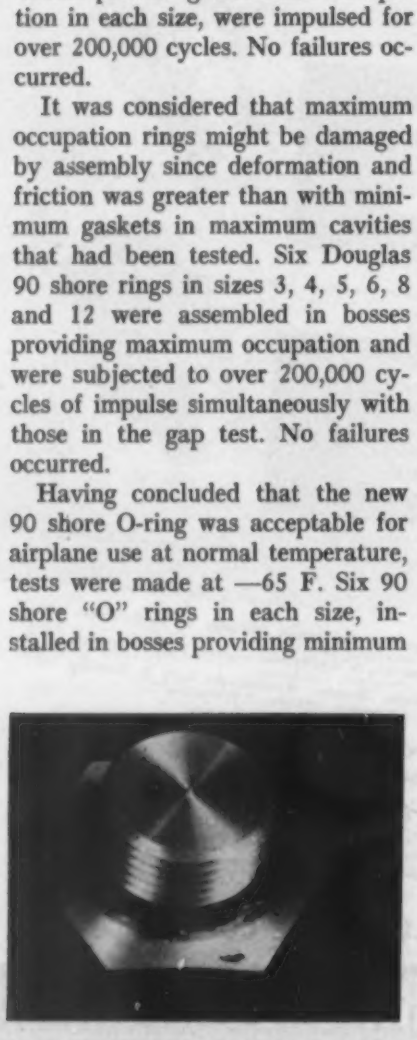
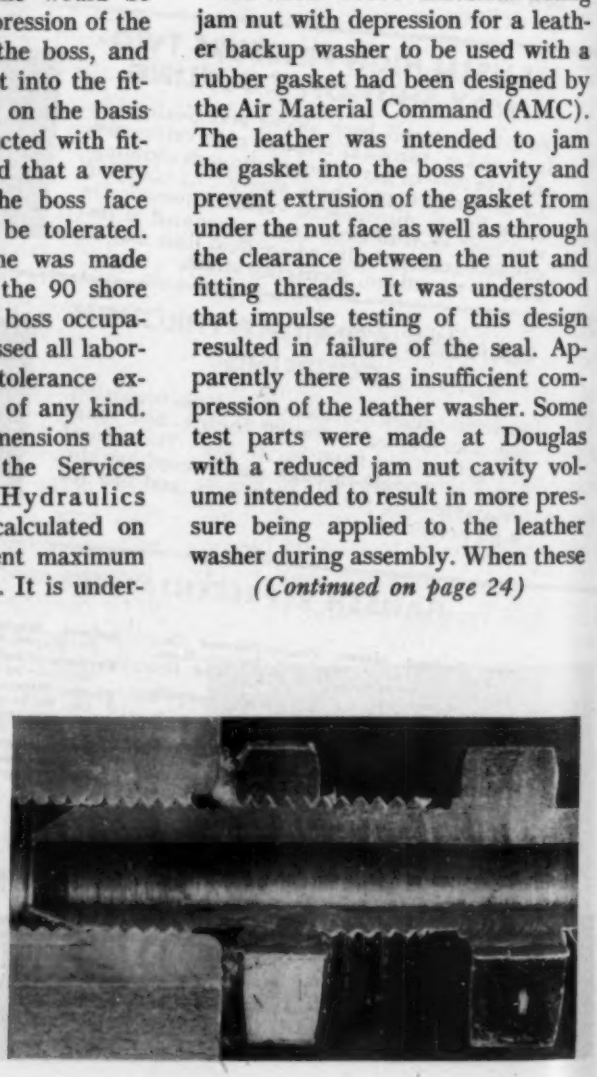


Fig. 6. AN902-10 gasket, showing damage due to assembly and less than 1000 pressure impulse cycles.

Fig. 7. Douglas-design universal fitting seal at approximately maximum occupation. The nut was tightened with normal torque and no thread lubricant was used. The gap between nut cutting lip and boss surface is approximately .040 in.

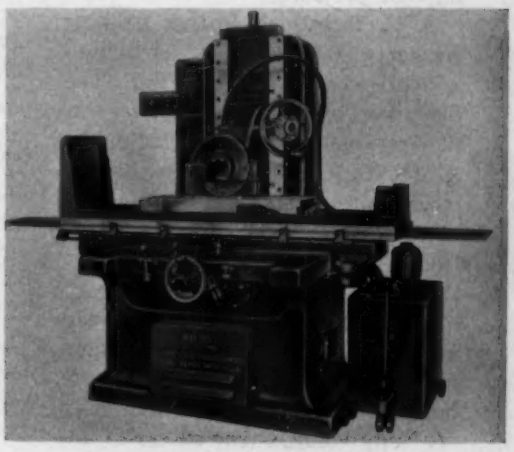


GALLMEYER & LIVINGSTON CO.

Hydraulic Feed Surface Grinders

The Gallmeyer & Livingston Company pioneered the manufacture of Hydraulic Feed Surface Grinders in this country over 18 years ago and these machines have been shipped to all sections of the world where machine tools are in general use. The company has selected the No. 55, one of the most popular grinders in the line and their model No. 80 Hydraulic Feed Universal and Tool Grinders for inclusion in this series.

No. 55 Grand Rapids Hydraulic Feed Surface Grinder



General: This model is in wide use in tool rooms and production departments both for dry and wet grinding (as illustrated); handles standard wheel 14 in x 1 in x 3 in at maximum longitudinal speeds in excess of 115 fpm. Two usable spindle speeds are provided, one for the full dia wheel, one for worn wheels, resulting in considerable saving in wheel cost.

Specifications: Bulletin No. GL-103.

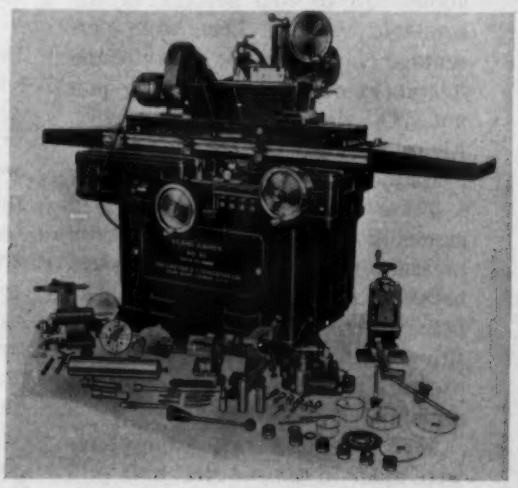
Hydraulic Circuit: Vane type constant displacement pump and relief valve, operating a differential cylinder for longitudinal table movement and actuating the cross feed mechanism with a control valve of their own design to provide for an infinite number of longitudinal table speeds.

Attachments Available: Bulletin No. GL-103.

Operator's Manual: Available on request.

Repair Parts Catalog: Available on request.

No. 80 Grand Rapids Hydraulic Feed Universal and Tool Grinder



General: This machine, available for dry or wet grinding, is designed for surface grinding of small parts, cylindrical and internal grinding, milling, form cutter, reaming, hob and gear cutter grinding and similar work.

Specifications: Bulletin No. GL-11-48.

Hydraulic Circuit: A vane type constant displacement pump and relief valve operating double single acting cylinders with special control valve, provides smooth, uniform longitudinal table movement at speeds from 6 in to 50 pfm.

Attachments Available: Bulletin No. GL-11-48.

Operator's Manual: Available on request.

Repair Parts Manual: Available on request.

GENERAL INFORMATION

Bulletins, Catalogs and Manuals for these and other G&L machines are available on request from Gallmeyer & Livingston Co., Grand Rapids 4, Mich. For replacement parts or service information give serial number of machine.

All Gallmeyer & Livingston machines, attachments and accessories are protected by issued and pending United States and foreign patents.

SAVE THIS VALUABLE REFERENCE MATERIAL: BUILD UP A PERMANENT FILE

HIGH PRESSURE SEALS

(Continued from page 22)

parts were assembled leather was extruded between the boss face and the jam nut preventing metal to metal contact. This brought to mind narrowing the edge of the jam nut to form a cutting lip which would allow the excess leather present under the majority of volumetric tolerance conditions to extrude and be cut off by tightening torque pressure. It was thought that the narrow cutting lip would approach the boss face closer than would the broad faced nut. This was expected to minimize the extrusion of leather between the boss face and nut when the seal was subjected to hydraulic impulse pressure.

A 1/8 inch-thick leather backing washer was designed, which fit into a depression in the jam nut. The diameter of this depression was placed equal to the diameter of the AND 10050 boss chamfer so it would not overlap the OD of eccentrically machined AN female fittings. Also, the depth of the depression was such that the volume of original uncompressed leather would exceed the total available maximum nut cavity volume plus maximum boss cavity volume minus minimum "O" ring volume. The excess of uncompressed leather varied from about 155 to 570 percent of the available volume. This large percentage variation was due to the tolerances of the boss, fitting, jam nut, "O" ring, and leather washer. Figure 1 shows this Douglas design.

Random tolerance parts in the —4 size were subjected to repeated assembly tests and 6000 psi static pressure was applied to the seals between assembly operations. The fittings were assembled to a new position each time. The parts held pressure until after 12 repeated assemblies.

Eight impulse test connections were made in the —4 size, four with minimum, and four with maximum seal cavity volume. Fittings were installed into the bosses to various depths representing the limits of production installation practice. Some leather-filled gap between the nut lip and boss face was evident on the minimum cavity assemblies. All eight connections were subjected to 200,000 impulse cycles and no failures occurred.

Because volumetric tolerance conditions appeared to be less critical on larger sizes, it was expected that larger size assemblies of equivalent proportions would be satisfactory. Parts were designed for fittings through the 1/4 in line size. Parts were made for maximum and minimum occupation assembly and cutaway tests in —5 through —10 sizes. From the tests that followed, it appeared that the use of steel jam nuts and fittings was necessary in order to allow application of sufficient torque to minimize leather gap with maximum occupation assemblies. The assembly torque used was approximately 1 2/3 times the maximum specified for steel fittings on the AND 10064 sheet. It was apparent also that if sufficient seal compression was to be obtained with the minimum occupation condition (approximately 150 percent) overflow would be present under the other extreme of maximum occupation (approximately 300 percent) such that considerable leather gap would exist. Therefore, the problem became one of obtaining sufficient leather compression for satisfactory sealing of maximum volume bosses, and yet limiting the size of leather gap that occurred with minimum boss volume to an acceptable amount as measured by satisfactory impulse test results.

At this time only the —4 size has been impulse tested by the Douglas Company.

Details of the above described universal fitting seal development were presented to the SAE Committee A6 in 1947. It was thought by industry hydraulics personnel that the Douglas design possessed certain advantages and that it should undergo more complete development and testing. AMC personnel agreed to undertake this work. Some work in this regard was done. However, it was reported that difficulties developed during this program that resulted in abandoning the design. The AMC then continued development of their earlier design. It is understood that the primary change to the original AMC design resulted in increased compression of the leather back-up washer. It has been reported that the latest AMC design passed all AMC laboratory tests.

BASIC HYDRAULICS

(Continued from page 16)

some similar "pipe dope" should be placed on the threaded portion of the pipe down to about the third thread from the end (Figure 54). The anti-seize compound should not be placed at the extreme end of the threading, or some particles may loosen into the pipe line and cause unnecessary damage in the system. It is placed on male fittings only, so that the screwing process will not push the compound into the system. To assure a good fit free from leakage, at least two-thirds of the threaded portion of the pipe should be screwed up into the fitting. The connection should be made tight with a wrench.

Chapter 4 is continued in the December issue with a discussion of flanged and compression fittings and an introduction to oil seals and packing rings. Please preserve for future reference.

Addenda to September Installment

E. H. Grauel, chief engineer, Helicoid Gage Division, American Chain & Cable Company, Inc., believes the statement (page 12, second paragraph), "since the surface on the outside of the curve is greater in area than the surface on the inside or shorter radius, the force acting on the outside of the curve will be corresponding greater than the force acting on the inside" is misleading. He writes: "This false thinking has been responsible in many cases for errors in equations which were developed using this as a base. Actually, you have neglected the moment of the tip area which, when added to the moment for the inside area, because it is working in the same direction, produces the same total moment what is obtained for the larger outside area. The effective moment, therefore, is zero, which indicates that the tube does not deflect because of the difference in the two areas. Actually, a Bourdon tube deflects because the pressure expands it into a slightly oval shape on the cross section. The inside radius is put into compression and the outside radius is in tension. The combination of tension and compression, since they are acting on opposite sides of the normal radius, causes the tube to expand in an upward direction but not necessarily vertically."

AN6289 nut and AN6291 leather washer have been released for use in combination with the new AN6290 gasket for the purpose of sealing the universal type fittings.

Butler Uses H-P-M HYDRAULIC Power System!

THE RESULTS . . . .
- ★ LOWER COSTS
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- ★ GREATER EFFICIENCY
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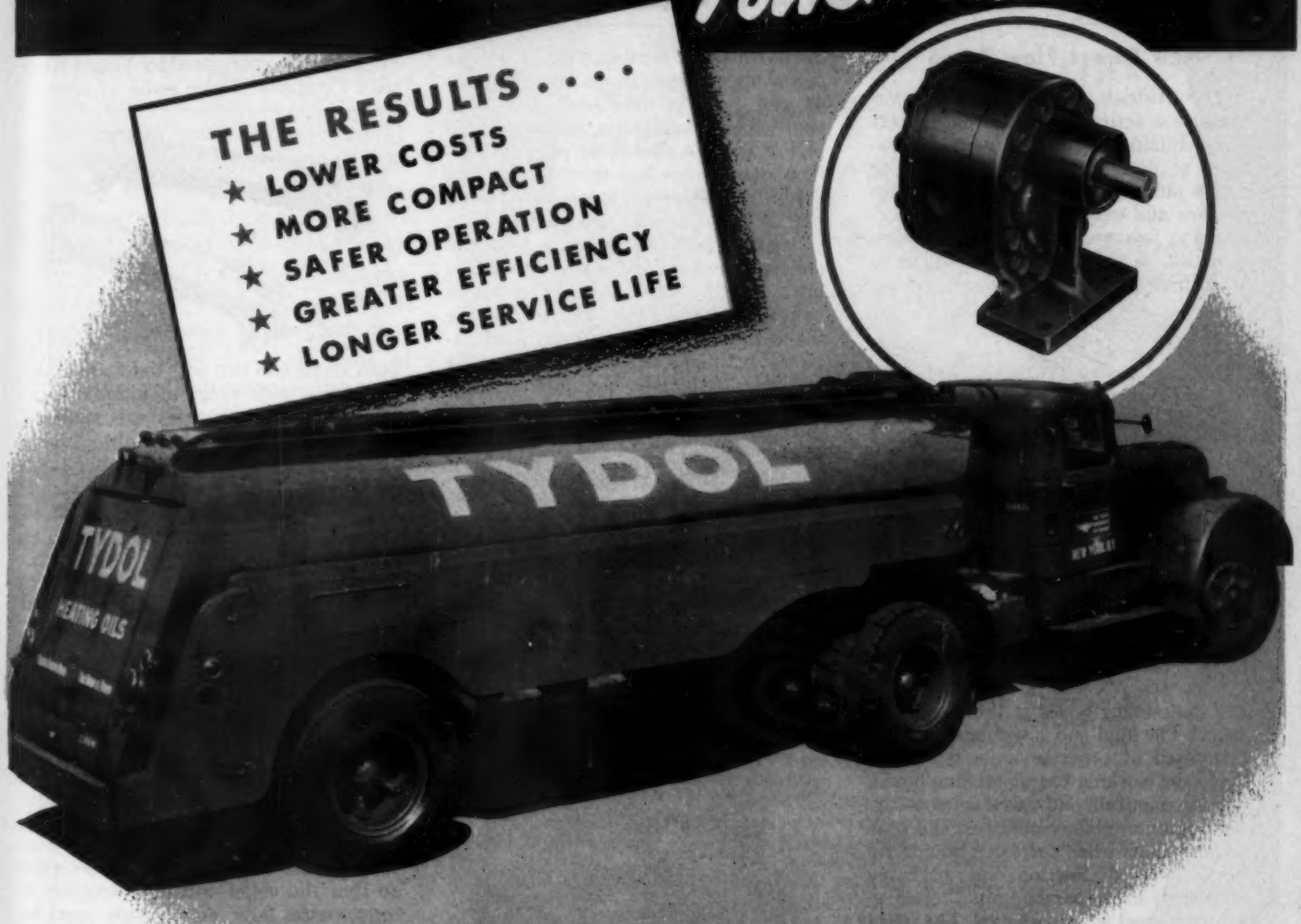

H-P-M gear pumps and fluid motors are finding wide acceptance on modern transports such as those built by Butler Manufacturing Company. A compact heavy duty H-P-M gear pump mounted on the tractor supplies power to the companion fluid motor located on the tank trailer. This motor drives the product pump used for unloading fuel oil, gasoline and other petroleum products. Modern H-P-M hydraulics have proven to be the safest and most efficient method for this job.

Put H-P-Ms to work on your push . . . pull . . . lift or rotating applications! Call in an H-P-M engineer to study your power requirements. Write today.

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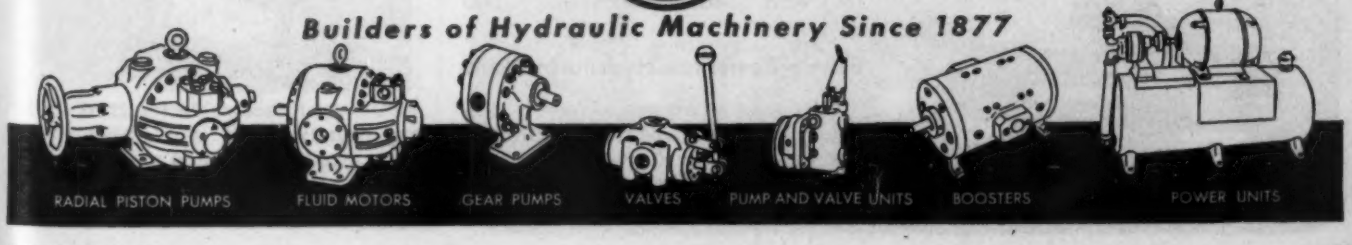
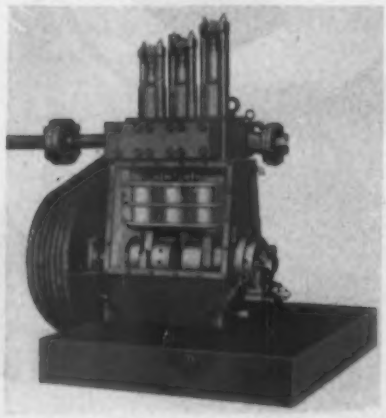


New PRODUCTS

For additional information on any of these products, mark the end key numbers on the card bound in this issue and mail the card.

New Direct Flow Pump

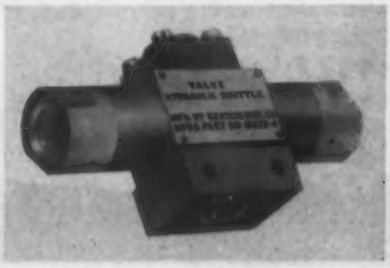
The Aldrich Pump Company announces a series of 5 in Stroke Direct Flow Pumps, incorporating new features of design and construction. The entire pump is designed for low maintenance and easy accessibility. An outstanding feature is the design and construction of the fluid-end, which as in all Aldrich pumps with inverted design,



has the stuffing boxes at the top of the pump. The fluid-end is sectionalized and composed of separate units which include the working barrel, stuffing boxes, suction manifold and valve units, assuring minimum replacement cost and time requirements when corrosive liquids are being handled. Suction and discharge manifolds are separate units, bolted to a forged steel working barrel. The valve assemblies including valve seats, held in place by the manifolding, are easily accessible. The series includes a triplex (three cylinders), a quintuplex (five cylinders), a septuplex (seven cylinders) and a nonuplex (nine cylinders) pump; hp ratings range from 100 hp to 275 hp. In this series all wearing parts are interchangeable except the main bearings. *1.*

3000 Psi Shuttle Valve

Kenyon Instrument Co., Inc., announces a 3000 psi shuttle valve, designed to AN 6277 envelope and mounting dimensions, for industrial as well as aeronautical applications. Available in ¼ and 5/16 in tube sizes, the valve shuttles at a maximum pressure of 50 psi; it will not shuttle or permit interflow at pressures less than 25 psi. The valve will shuttle against a blocked line. With a pressure drop of less than 10 psi at rated flow and leakage less than two drops per cycle, the shuttle will not unseat from surge flows or negative pressures. Surge flows will not displace the seals. Designed to meet rigid extreme temperature operation, impulse and endurance testing, the long, precision life of the valve gives an extra margin of reliability for industrial equipment operation, particularly where downtime is critical. *2.*



Hydraulic Power Units

The first complete line of hydraulic power units to be offered by a west coast manufacturer has been announced by The Rucker Company. Over 40 models and a number of accessories are expected to fill needs of any industrial fluid power requirement. Features include single or dual pressure systems,

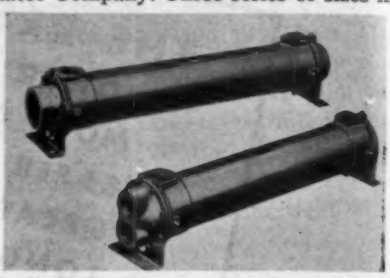
constant or variable volume pumps, oversize reservoirs, provision for ample oil filtration, dual drain connections, air and water eliminating reservoir. Optional heat exchangers, immersion heaters and other controls are available. Standard power units from 2 hp to 75 hp, special units to 300 hp, are available for working pressures of 1000 and 2000 psi, with special models to 10,000 psi. *3.*

Flame Resistant Hydraulic Fluid

Celanese Corporation of America announces the development and production of Lindol HF-X, a new, flame resistant tricresyl phosphate base hydraulic fluid. Lindol HF-X does not give off noxious fumes when exposed to high temperatures, it is corrosive resistant, retains high lubricity and is low in cost. It is available in a wide range of viscosities and viscosity indices and can be used in any system equipped for non-hazardous hydraulic fluid operation or in any other system with but few changes. *4.*

Tube and Shell Heat Exchangers

A new line of stock type "F" (fixed tube bundle) tube and shell type heat exchangers is announced by Young Radiator Company. Three series of sizes in



both single and two pass units are available for a wide range of industrial capacities. The exchangers are made of corrosion-resistant Admiralty tubing and are designed to handle either fresh or salt water requirements. The standardized units offer economies due to mass production, unit purchases of standard sizes, deliveries from warehouse stocks and maintenance savings through design and construction and standardized parts replacement. *5.*

CIRCLE NUMBERS ON THE CARD AND MAIL!

Air Powered Collet Chuck

The Bellows Company announces the development of a new heavy duty "Controlled-Air-Power" collet chuck with "dead man" safety control. Known as model BZC-10, the circuit is designed so that the collet will hold securely if air pressure fails; air pressure must be applied to release the work. At 60 psi air line pressure gripping power equals approximately 185 foot pounds torque, sufficient for many types of drilling, tapping and milling. The BZC-10 handles most standard collets with stock clearance to 1⅜ in; with an adaptor it will handle practically any standard externally threaded draw type collet. The chuck may be mounted in any position

and is easily adaptable for cross drilling operations. It is available either with manually operated valve or electrically controlled air-powered valve. *6.*

(Continued on page 28)

J.I.C. TUBE STANDARDS

(Continued from page 11)

fail or until they have been subjected to 10,000,000 cycles. Cycle life of the qualifying fitting must equal, or exceed, that of the companion AN fitting tested. With the tubing under identical stress as described, a chart of typical results of these tests is shown as Figure 4.

It would be difficult to supply a more comprehensive performance qualification routine than that "borrowed" by the J.I.C. from the aeronautical field as a requisite for Conference-approved fittings.

While other sections of the standard dealing with other hydraulic elements and practices could not be so simply formulated, it is clear that the J.I.C. Standard itself aims at high-level performance for the equal benefit of the equipment designer, the component manufacturer, the user and the hydraulics field in general.

FLUID DRIVE

(Continued from page 13)

moved to the off or manual position.

The performance of the fluid drive has fully satisfied the requirements of the operation. In addition to compact size and convenient mounting of the fluid motor, the easy accessibility of motor, pump and valves has made service and maintenance a very simple problem.

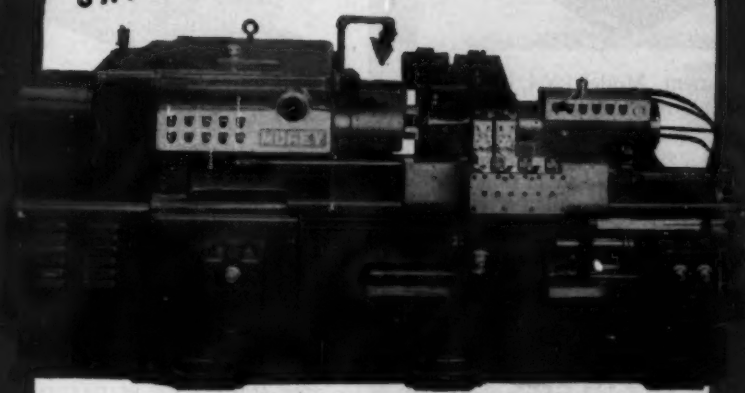
Our customer has been very pleased with the smooth and trouble-free operation of the equipment. The flexibility of control has reduced machine downtime; production, including irregularly timed changeovers, has been above original estimates made for the machine.

Credit Due

The article "Four Second Cycle Die Casting" which appeared in our October issue under the byline of Walter R. Ellis described a hydraulic circuit used in a die casting machine designed by the A. R. D. Corporation, 70 Pine Street, New York 5, N. Y. We are sorry that the reference to the actual designer of the machine was not included in the original story.

GREER ACCUMULATORS

ELIMINATE PUMP AND VALVE...
MAINTAIN CONSTANT PRESSURE...
SAVE 10% OF MACHINING TIME



Mr. R. Kurzweil, Chief Engineer of Morey Machinery Co. Inc. writes: "Two types of Greer Accumulators are used on our Model DB Lathe shown above. Two A1 M are used in one part of the circuit for maintaining pressure in one part of the system regardless of any pressure drop in the rest of the system. To accomplish this without the accumulators, an additional pumping unit and related valves and manifolds would be needed. This would make the equipment substantially more expensive. The second type accumulator, A5 H, is used as a volume storage chamber to increase the speed of rapid traverse on all slides. The accumulator reduces idle time by 5 to 10 seconds amounting to about 10% of machining time."

Our thanks to Mr. Kurzweil and numerous other satisfied customers in all phases of industrial hydraulic application who have discovered new standards of economy and efficiency through the Greer Accumulator.

If you have hydraulic actuated equipment it will pay you to investigate how a Greer Accumulator can benefit you.

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GREER HYDRAULICS INC.

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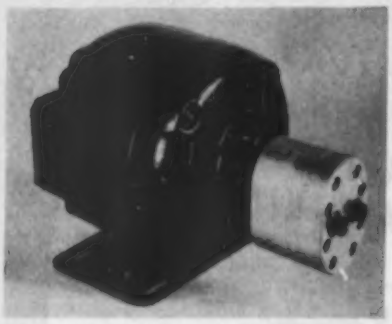
(Continued from page 26)

Quick Change Oil Pump

Eastern Industries, Incorporated, announce a new gear, positive pressure oil pump, designed for quick oil change



equipment. Model 1304, illustrated, offers features new to a single hydraulic pump; pump is close coupled to the motor, assuring perfect alignment and reduces sizes and weight to a minimum; it is ruggedly constructed, quiet in operation and precision built for long life and high efficiency. Coupled to a ¼ hp, 1725 rpm, split phase motor, the pump delivers 1½ gpm at 200 psi. *7.*

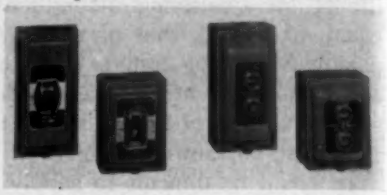
New Air Cylinders Without Tie Rods

The Tomkins-Johnson Co. announces a new line of improved type air cylinders, designed to meet requirements of manufacturers of finest machine tools and industrial equipment. Features include: elimination of tie rods, improving appearance of equipment on which installed; external surfaces easy to clean; eliminates stretching of tie rods, troublesome on very long stroke cylinders by allowing leakage between cylinder heads and body; and elimination of longitudinal compression or column stresses. Round snap rings, seated in grooves in the cylinder body and steel clamping collars replace tie rods. The

new cylinders are available in the same range of sizes as the company's tie rod type for pressures 80 to 100 psi, in seven different styles, up to 8 in bore, with or without adjustable cushions. *8.*

Manually Operated AC Starters

General Electric's Control Divisions announce a new line of manually operated starters for ac motors up to 7½ hp, especially designed for powering pumps, farm machinery, blowers and small industrial machines. Both toggle and push button types in 2-, 3-, and 4-pole forms, sizes 0 and 1 are available. Toggle types are also furnished, if desired, with cast iron enclosures for wet, dusty or hazardous locations. A feature is their bimetallic overload protection, providing exceptionally accurate response to overloads. The starters



are equipped with heaters which follow closely the motor heating curve. All general purpose enclosures can be padlocked, the toggle type in both ON and OFF positions. *9.*

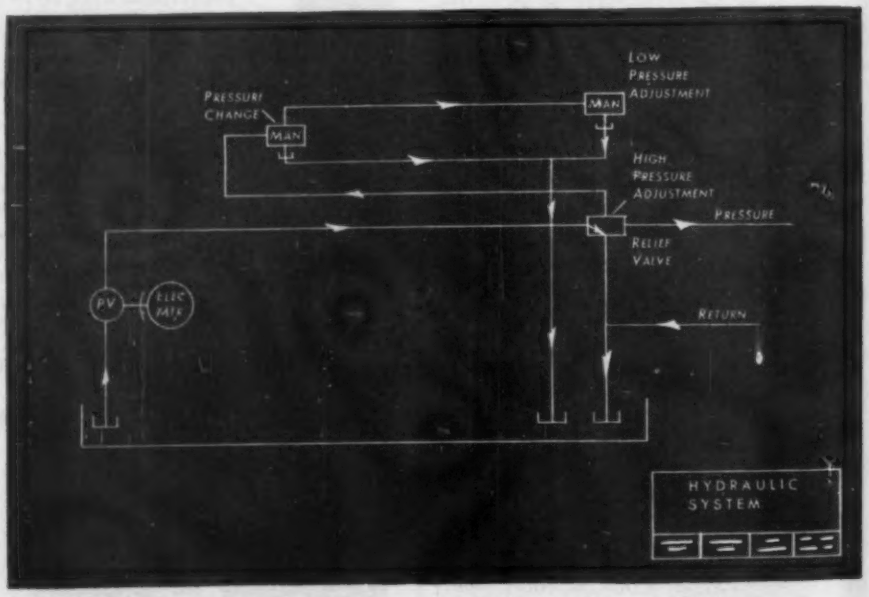
Flexible Hose Assemblies

New high pressure, two-braid rayon assemblies with pressed-on couplings are announced by J. N. Fauver Co., Inc. Designated as Type RR-2 Rayon Braid Hose and available in sizes ¼ to 1 in ID and in any combination of male and female solid or union couplings, the hose is constructed of a synthetic core, two-

ply braided rayon cords and neoprene cover. Burst pressure is 2400 to 6000

The Superior Tube Company has made a specialty of producing seamless steel tubing for use in hydraulic and other types of pressure systems. For pressure loads above 200 psi, Superior Tubing is cold drawn to meet the following hydraulic tubing specifications—

J. I. C. Hydraulic Standards;
AMS 5050-B.



By selection of raw materials, the steel used is of a *non-aging type* made under special melting practice to insure low yield strength and unusually high elongation. Superior hydraulic tubing is given a *100% hydrostatic test*, and, in addition, is tested for *flareability*. The tubing is soft and ductile and remains soft for bending and flaring. Standard sizes are available for prompt delivery from Superior representative-warehouses.

Gentlemen: Please send me Bulletin #38 giving complete information on Hydraulic Tubing.

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All analyses .010" to ⅝" O.D.
Certain analyses (.035" max. wall) up to 1⅛" O.D

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psi, depending on the diameter. It provides a highly flexible conductor and inexpensive hose assembly for use practically anywhere wire assemblies have been used. On hydraulic circuits for welding or where electricity is involved, the design eliminates the shorting hazard. *10.*

Remote Control Valve

A line of solenoid operated three and four-way automatic valves for remote control is offered by Clark Cooper Company. Featuring balanced micro-honed

piston, the valves are suitable for cylinder operation, or as pilot valves for larger valves that require flow in several directions automatically. Pipe sizes ⅛ to ¾ in and larger, both single (with spring and gravity return) and double solenoid types are available. Bronze bodies are standard, with special alloy bodies and explosion proof housings available. *11.*

Capillary Bleeder Pressure Gage

The Clapp Instrument Co. announces the development of a new integral capillary bleeder for use with their Acragage. Designed for use in pressure gages operated on sealed hydraulic systems or wherever pressure lines must be purged, the bleeder permits complete purging of air from the bourdon tube at all times. Since air bubbles left in the

tube by normal evacuation result in gage inaccuracies as high as 4 percent, the new bleeder is expected to be of great value on sealed system pressure gages. *12.*

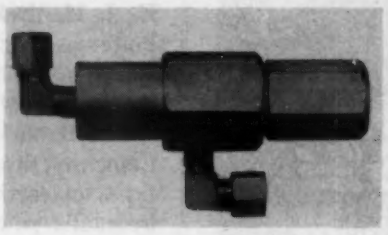
Tube Bending Machine

A new semi-automatic hydraulic tube bending machine is announced by Pines Engineering Co. Completely self-contained, the new unit is designed for speedy handling of production jobs or short run and maintenance bending work requiring frequent changeovers of setups. Designated as series 1400 bender, it will handle tubes and pipe up to 5 feet in length and 1 in OD 16-gauge steel tubing, with a maximum bending radius of 8½ in to centerline of tube. It is easily tooled and readily adaptable to tubing, pipe and bars as well as rolled or extruded sections. The hydraulically operated bending arm is powered by a pump which delivers 7 gpm at 1000 psi, operating the arm at a speed of 29 rpm to form between 100 and 400 bends per hour. *13.*

CIRCLE NUMBERS ON THE CARD AND MAIL!

Compressor Tank Drain

A new tank drain which automatically removes the water that collects in the compressor tank has been developed by the Quincy Compressor Co. According to the announcement, the new tank drain, DRI-R-AIR, completely eliminates manual draining on all types of



air compressors having bleed or pressure type unloaders. Installation of the new tank drain can be made with a few feet of ¼ in OD copper tubing and a standard "L". The drain is made of non-corrosive, rust-proof brass with only one moving part. *14.*

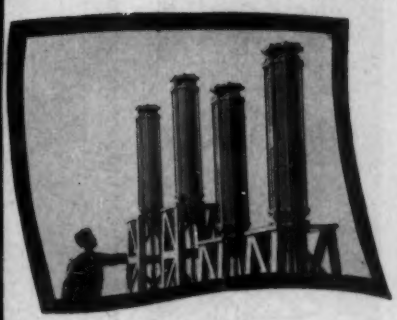
Hydraulic Dump for Pick-up

A new low-cost dump body and hydraulic hoist for pick-up trucks is announced by Woodson Products. The Woodson Dumper can be easily and quickly installed on any make of ½, ¾ or 1-ton truck without alteration to the truck chassis or equipment mounted on it. The heavy-gauge steel body, 80 in by 66 in by 16 in, is mounted low and loads are lifted at lower hydraulic pressures than required with an underbody

hoist. The double acting tailgate has a sliding door for bin loading. Drive is either by power take-off, or more usually in a light truck, the pump is direct driven by a 6 v d c motor; a one-ton load in the body draws only 85 amps for 40 seconds when raised to the full dump position. In either drive, the body may be stopped and held at any intermediate position. *15.*

Ledeen heavy duty cylinders helped do this job better

OPERATING
REFINERY
GATE VALVES



APPLICATION—The 8" diam. x 36" stroke Ledeen heavy duty cylinders, illustrated here, are used to operate 24" and 30" diam. gate valves carrying hot oil. Refinery layout makes remote control necessary. Controlled from the central point Ledeen cylinders provide instant and easy action of all gate valves.

INSTALLATION—These cylinders operate hydraulically, connected to a 500 p.s.i. pump and reservoir. Attached to derrick-type brackets, this assembly in turn is mounted on the gate valves. Piston rods of cylinders are connected to extension rods that go into valve gates.

Perhaps you too have a job that can be improved by Ledeen heavy duty cylinders.

Wherever you have to...

PUSH OR PULL, LIFT OR LOWER, PRESS OR SQUEEZE, TILT OR TURN, OPEN OR CLOSE,

Ledeen heavy duty cylinders, operated by air, oil or water, will do it for you better and surer.

Standard Ledeen Cylinders with rod or head attachments are available from distributors' stock in major cities. Special cylinders on order.

Write for Bulletin 453.

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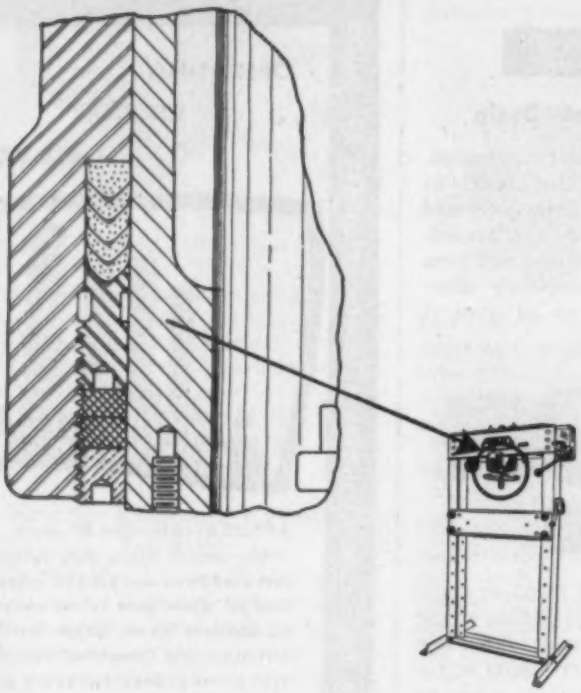

American Chain & Cable's popular Manley 40 ton hydraulic press, made for rough treatment and long use, is featured with a packing assembly built for trouble-free service!

To assure maximum efficiency and uniform pressure maintenance for the entire unit, Manley engineers specified Linear V-type packings for this compact packing installation. *Automatic—selfsealing—Linear V packings seal from zero to peak pressures, reducing wear and frictional drag to a minimum.* And note in the packing design, how wiping rings are used to prevent dirt and grit from working into the packing. No wonder this packing installation puts money in your pocket with lowered maintenance cost!

This is only one of many thousands of applications where Linear homogeneous or fabric-reinforced V-type packings are sealing against air, steam, water, gas, oils and solvents over a wide temperature range. If you wish to design your packing assembly for lower costs and more efficient operation, specify a quality packing—SPECIFY LINEAR V-RINGS!

"PERFECTLY ENGINEERED PACKINGS"
LINEAR
LINEAR, Inc., STATE ROAD & LEVICK ST., PHILADELPHIA 35, PA.

APPLIED HYDRAULICS DIGEST

Abstracts, summaries and listings of articles on hydraulic and associated applications in industry; reports on prepared papers, talk and discussions pertinent to the hydraulics field.

Hydraulic Power as Applied to Earth Moving Equipment

E. J. Hrdlicka, from preprint of paper, "Hydraulic Power as Applied to Earth Moving Equipment," presented at the SAE National Tractor Meeting, September 13-15, 1949, Milwaukee, Wis.

Mr. Hrdlicka, vice president, Hydraulic Equipment Company, discusses the principal features of the major types of earth moving machines and the part which hydraulic power contributes in carrying out the features. Features of the basic hydraulic systems for bulldozers, tractor shovels, scrapers, loaders and graders as well as special types of earth moving equipment are described and illustrated. Standard hydraulic equipment for such manufacturers as The Baker Mfg. Co., Tractormotive Corp., Bucyrus-Erie Co., The Frank F. Hough Co., Allis-Chalmers Mfg. Co. and The Euclid Road Machinery Co. is described both from viewpoint of design and operating features. The special machines described include the Gradall, a general purpose contractors' machine with all operating cycles hydraulically controlled, a product of the Warner Swasey Co. and the M-R-S tractor, built by the M-R-S Mfg. Co., which operates on the weight transferring principle. A cylinder can transfer weight from the front wheels of the trailer to the drive wheels of the tractor by actuating the control valve. The amount of weight that can be thus transferred is varied by a pressure adjustment of the two relief valves in the control valve.

The use of both low pressure strainer or filter elements and of high pressure strainers (between pump and valve) were discussed and the advantages pointed out in terms of efficiency of cleaning all foreign materials from the hydraulic system. The gradual replacement of pipe and pipe fittings by steel tubing welded to flanges bolted together and sealed with "O" rings and the use of improved hose, tubing and their fittings were illustrated. Finally, Mr. Hrdlicka pointed out the importance of the use of the proper grade of the hydraulic oil best suited for each system. He urged that additives be left to the oil manufacturer and that oil be changed frequently. He predicted that higher operating pressures up to 3000 psi will be used in hydraulic systems for earth moving equipment, stating that educational programs in hydraulic product maintenance will make high pressure systems a reality in the future.

Care and Feeding of Hydraulic Oils

Anonymous, *Oilways,* v 16, September 1949, pp 12-15.

Examples of the damage caused by oil contamination in a number of hydraulic machines and the use of continuous or batch filtering methods to keep hydraulic oils clean. An authority is quoted to the effect that 90 percent of all trouble with the 5000 or more hydraulically operated injection molding machines, for example, is the result of contaminated oil. A 20 gpm variable delivery piston pump delivering oil to the cylinder of a machine used to run-in hydraulic cylinders after they had been machined and honed had to be taken apart every three months to replace worn parts. Investigation disclosed that abrasive material in the oil, that passed through a strainer with 0.005 inch openings, was responsible, in spite of the fact that the cylinders were washed with gasoline and blown with compressed air. A line filter ahead of the pump corrected the trouble. A forging shop used 3000 gallons of oil every five or six months because of oil sludging and cleaning the oil system took up to four days. A dolly mounted portable filter and a change to more stable oil, now permits this company to use their oil indefinitely. The cleanliness of containers and storage tanks or drums is important, suggestions are given for good operating procedures.

Types of contaminants including water and air in hydraulic oils are reviewed and suggestions for their elimination or control are given. Suggestions on oil seals and hose, operating temperatures and additives are practical. The article is well illustrated with diagrams and photographs of typical hydraulic installations.

Air Replaces Hand Control

William R. Apblett, *American Machinist,* v 93, October 6, 1949, p 121.

Experience has shown that properly applied air cylinders have resulted in considerable savings in operating fixtures at the Sangamo Electric Company at Springfield, Ill. Air cylinders controlled by small solenoid valves and micro switches have been built into a number of assembly fixtures and bench presses; parts production and sub-assembly operations on many meter components have been simplified. Two dual switch setups, illustrated, serve a dual purpose. One switch is used to set the control circuit when the workpiece is properly positioned, a second switch actuates the air cylinder at the operator's touch, insuring that the work piece is in place and that the operator's hands are out of the danger area.

Gas Turbine-Torque Converter as a Power Plant

Frank L. Schwartz, from an address delivered before the Fall Meeting, American Society of Mechanical Engineers, September 29, 1949, Erie, Pa.

The automotive gas turbine, now in an experimental stage, is smaller, cheaper and lighter than the present auto engine. Its advantages are fewer moving parts, low oil consumption, smooth operation, no need for anti-freeze, elimination of automatic transmissions and ability to use low grade fuels. In comparison, the gas turbine for automotive power plants offers a simple device consisting of a prime mover and torque con-

Compact Power

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FLUID MOTORS

3 hp to 128 hp Models!

Remarkably compact design . . . Stepless speed variation . . . Control valves for rpm regulation . . . Shockproof stop-and-start operation . . . High volumetric efficiency . . . Self lubricating . . . Self-starting from any position.

In addition to such outstanding features these drives have the stamina and capacity to withstand long, hard service beyond the ability of ordinary motors. Their use is recommended where space, power and endurance are important. Denison fluid motors may be stopped, started, reversed — used for braking — at full rpm and pressure. Smaller sizes are available with gear reduction attachments and instant speed-up controls for variable speed requirements. All are available for either face, flange or foot mounting. Capacities up to 3000 rpm, 128 hp, 5000 psi. Write for further information.

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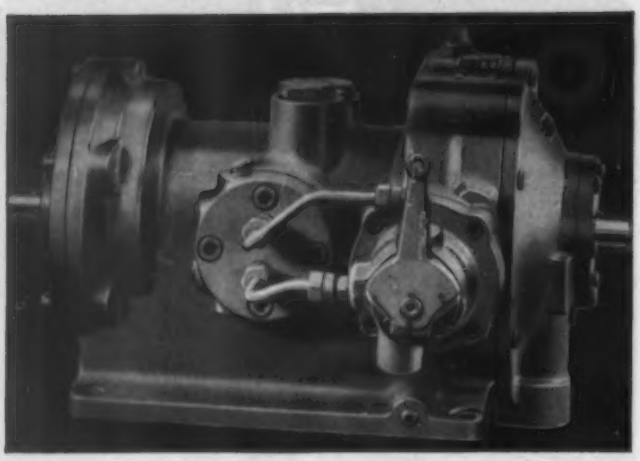


Oilgear Fluid Power Transmissions

Two-way variable speed. Up to 3 h.p.
Output 0 to 1600 R.P.M. (Reversible)
Lighter • Simpler • Sturdier • Smoother

The outstanding fact about these new, small and versatile Oilgear Fluid Power Transmissions is that during the past 5 years more than 100 thousand similar units have been built, tested and *proved* in the toughest trials devised by man. They weigh only 90 lbs. They are ruggedly constructed throughout, simple in design, dependable in performance, smooth in operation. These compact units are *complete*, enclosed and sealed against dirt, with integral relief valves in the fluid passages for protection against overload.

These transmissions efficiently convert a *constant* rotary motion into accurately controllable *variable* rotary motion. They provide smooth, stepless, uniform acceleration from zero to maximum in either direction. Their positive drive is not affected to any appreciable degree by variations in load. They use little power, and always in proportion to work done.

They provide flexibility of location with convenient nearby or remote control and offer a choice of manual, electric or hydraulic controls. They provide quick, cushioned reversal . . . and a host of other advantages.

These transmissions are now used on starch machines, conveyors in many industries, wire rewinders, spring coiling machines, furnace drives, material supply pumps, gangsaw feeds, grinding wheel head drives and many other machines and processes. THE OILGEAR COMPANY, 1564 W. Pierce St., Milwaukee 4, Wisconsin.

Ask for New Bulletin

Bulletin 67110 completely describes the new small Oilgear Fluid Power Transmission. A copy will be sent free at your request. Write today.

Oilgear Fluid Power

PUMPS, MOTORS, TRANSMISSIONS, CYLINDERS AND VALVES

verter in a single unit. Only two rotating elements and a single speed reducer are required. It is one of the few prime movers capable of producing high starting torque at low speed as the turbine exerts its maximum torque at zero speed.

The gas turbine proposed for vehicle propulsion consists of two separate turbine wheels in which the gas flows in series, one to drive a compressor and one to supply power to the vehicle. Several American companies have designed and built small gas turbines; one of these the Boeing gas turbine is a 200 hp unit weighing only 150 pounds. There have been several developments in Europe also.

Plant Instrument Shop Testing Equipment

Hart U. Fisher, *Instruments,* v 22, September 1949, pp 794-197.

An excerpt from a paper presented at the Fourth Annual Conference of the Instrument Society, September 12-16, St. Louis, Mo.

This is a clear presentation of the basic instruments required for operating and for testing instruments commonly used in industrial plants. The suggestions should be of particular value to shops and departments that wish to check and maintain the accuracy of instruments as one of their own service functions. Thermocouples, bulb types of temperature instruments and optical pyrometers are treated briefly. Dead weight testers and three types of manometers—well type for low pressures, open type with mercurial barometer or closed-leg absolute pressure type for vacuum or below atmospheric pressure and inclined-tube manometers for small vacuums or pressures of two inches or less. Testing setups are described and shown in diagrams. A portable test rig used with the Ledoux-bell type of instrument. Test procedures for positive-displacement meters and rotameters are described.

Two of the most commonly used electrical instruments—the 0-60 millivolt portable potentiometer and the type "K" potentiometer are included in the discussion, as also are a tube checker and the new small battery testers. A portable two-pen pressure recorder, its hookup, adjustment and use, is described in detail.

Selecting Magnetic Relays for Industrial Controls

H. F. Littlejohn, Jr., *Product Engineering,* v 20, September, 1949, pp 89-93 and October, 1949, pp 140-145.

The two articles cover the basic magnetic relay types and applications. The first article lists nine factors governing the selection of industrial type magnetic relays and discusses how each factor affects relay performance. The nine selection factors are given as: (1) the operating voltage, and the current and power necessary to actuate the relay; (2) the contact ratings required; (3) the contact combinations available; (4) the operating speed; (5) the operating life cycle; (6) the method of mounting; (7) the type of enclosure necessary; (8) environmental conditions encountered in service; and (9) initial cost. Two tables, one listing electrical characteristics of typical magnetic relays, the other constructional features of standard magnetic relays for industrial controls and illustrations of representative relays, make the material convenient to use.

The second article lists steps in the logical method of approach to select industrial type relays and describes and gives applications and limitations of low voltage relays, including (1) heavy duty; (2) midget; (3) miniature; (4) sensitive; (5) time relay; (6) field control; (7) series; and (8) special types of relays. Capacitor motor starting relays and latching relays are discussed under special types. Photographs, schematic diagrams and a table of relay symbols add to the reference value of the article.

How To Choose And Use Portable Tools

H. P. Bailey, *American Machinist,* v 93, August 11, 1949, pp 114-117.

In this article of a series, air power distribution is discussed and the author points out that the most frequent cause of trouble with air tools is insufficient pressure, caused by undersize main and downpipes and hose. The use of the hypodermic-needle air gage to determine the actual pressure delivered to the tool while it is running is described and suggestions for testing pressure are given. A procedure for determining exactly what happens to production under low pressure is outlined and a remedial procedure is suggested. Accompanying tables show how to figure correct sizes of pipe for main and downlines. The author points out that the main difficulties in air power distribution lines lie with the hose between the valves and the tools. This is due to the heavy weight of many hoses, the inferiority of wartime hose with its short life and the "particularly vicious practice" of using hose menders. The use of the new, lightweight, flexible hose, chemically treated inside, eliminates many of the older difficulties. Its higher cost is more than compensated for by longer life and ease of handling. A cost analysis of operating efficient air tools vs inefficient tools is given.

Hydraulic Chucking Devices for Lathe Applications

Harry L. Stewart, *Product Engineering,* v 20, September, 1949, pp 124-125.

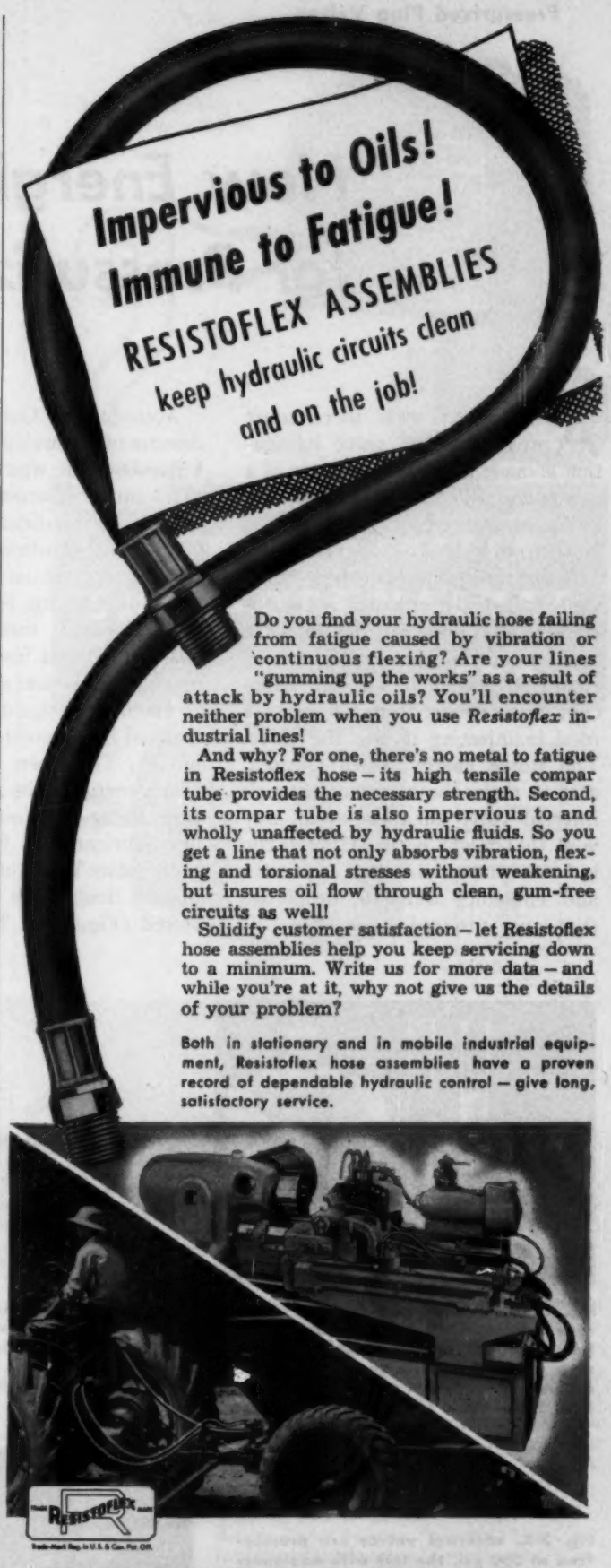
A series of six schematic drawings with brief descriptive notes on internal and external hydraulic chucking, hydraulic chuck and tailstock, hydraulic chuck and feed, hydraulic chuck and automatic feed and hydraulic chuck with electric controls cover good representative installations.

Do Machine Tools Cost Too Much?

E. J. Tangerman, *American Machinist,* v 93, September 8, 1949, pp 89-92.

The author shows by a number of actual examples that, while the prices of machine tools have been increased, values, or returns in increased production, have increased at a greater rate. Several examples cited are of special interest. A machine tool which cannot be tooled with carbides cost $7920 in 1939 and $13,905 in 1948. A new and improved model, introduced last year, is priced at $15,250 but it will do 50 percent more work than the old. In 1924 a small steel part, made from ¼ in stock, with ¼ in threaded ¼-24 and a ⅛ in shank 3/16 in in dia was made from ¼ in B7B

(Continued on page 35)



Do you find your hydraulic hose failing from fatigue caused by vibration or continuous flexing? Are your lines "gumming up the works" as a result of attack by hydraulic oils? You'll encounter neither problem when you use *Resistoflex* industrial lines!

And why? For one, there's no metal to fatigue in Resistoflex hose – its high tensile compar tube provides the necessary strength. Second, its compar tube is also impervious to and wholly unaffected by hydraulic fluids. So you get a line that not only absorbs vibration, flexing and torsional stresses without weakening, but insures oil flow through clean, gum-free circuits as well!

Solidify customer satisfaction – let Resistoflex hose assemblies help you keep servicing down to a minimum. Write us for more data – and while you're at it, why not give us the details of your problem?

Both in stationary and in mobile industrial equipment, Resistoflex hose assemblies have a proven record of dependable hydraulic control – give long, satisfactory service.

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SYNTHETIC FLEXIBLE PRODUCTS AND PARTS FOR INDUSTRY

New Energizable Lubricant for Pressurized Plug Valves

AN ENTIRELY NEW METHOD OF providing plug valve lubrication is made possible by the use of a new energizable lubricant, according to an announcement made by the Nordstrom Valve Division, Rockwell Manufacturing Co. The new lubricant, called Hypermatic, is considered the most important development since the introduction of Nordstrom valves 30 years ago. The new lubricant draws energy from the pressure used in injecting it into the valve. The stored energy, when released, acts to move the lubricant through internal valve channels to fill any void that might occur. Hypermatic is both compressible and expansive and embodies dynamic properties that cause it to feed as needed.

According to George F. Scherer, director of research of the Nordstrom Valve Division, who created the new lubricant, Nordstrom valves will now need to be relubricated only 20 to 90 percent as often, depending on the frequency of use. Savings in man hours of servicing is expected to be revolutionary; these savings are possible without investment in new mechanical devices or equipment.

The new lubricant in stick form is inserted in a Nordstrom valve (Figure 2). The screw is then inserted which energizes the automatic lubricant. Being compressive, more of the new lubricant can be stored in the same valve. By actual tests, approximately double the volume can be stored (Figure 1). Tightening down of the lubricant screw energizes the lubricant to any desirable pressure. As the lubricant is gradually consumed, the pressure will drop slowly; it will not drop abruptly as in the case of non-compressive lubricants. Figure 3-A shows two identical valves, both pressurized to 350 psi, the left-valve with non-energizable lubricant, the right with automatic energizable lubricant. Figure 3-B shows the same valves after six months of operation.

Hypermatic automatic lubrication is applicable to all types of Nordstrom lubricated valves; it will successfully operate in pressurized plug valves of all sizes on a pressure as low as 50 psi; for high pressure service the lubricant pressure can be built to 1000 psi or higher.

The new lubricant is available for use in the petroleum industry, the gas industry and for handling aqueous fluids such as water, non-reactive aqueous solutions and for many chemical processes. It will increase valve efficiency by (1) keeping valves in a fully lubricated state; (2) by decreasing frequency of servicing; and (3) by maintaining the valve in operable condition for emergencies without stopping to re-lubricate.

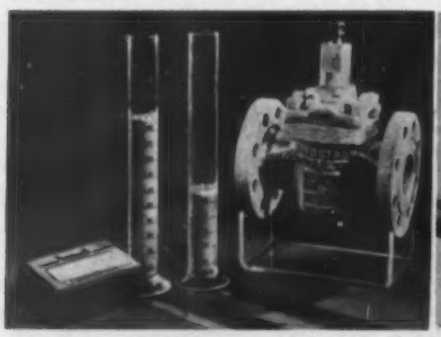

Fig. 1. The amount of automatic lubricant storable in the valve shown (left tube) is approximately double the volume that of non-compressible, non-automatic lubricant (right tube) storable in the same valve.

Fig. 2. The new lubricant in stick form inserted in a Nordstrom valve. Energized automatic lubrication is obtained by turning down the screw. A form for grease gun application is also available.

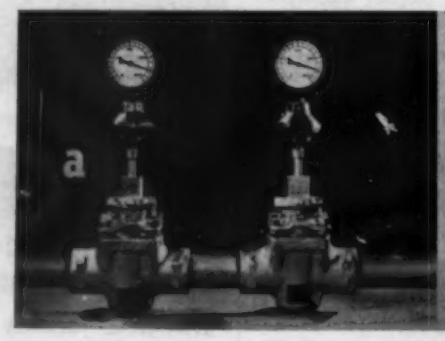

Fig. 3-A. Identical valves are pressurized at 350 psi, the left with non-energizable lubricant, the right with automatic energizable lubricant.

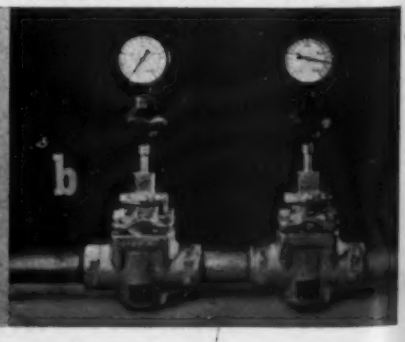

Fig. 3-B. The same valves shown in 3-A after six months of operation. The left valve pressure has dropped to 0 psi, left; right valve pressure shows negligible drop.

(Continued from page 33)

or SAE1112 CRS. The machine was a Brown & Sharpe No. 00G regular automatic screw machine with slotting attachment and attachment belt-driving stand. Production was 290 per hour. The machine cost $1525 and was tooled with carbon steel. In 1949, the same part would be made of ¼ in B-1113 or B & S 12A on a No. 00G high-speed automatic screw machine with motor drive and slotting attachment and carbide tooled. Production would be 1028 per hour—or 3½ times as much—for an investment of $4070—or 2½ times as much. To produce the same output with 1924 machines would require an investment of $5398.50 or one-third more. Further, adjusting the value of the dollar in accordance with the "Purchasing Value of the Dollar" statistics of the National Industrial Conference Board, for August, 1948, the investment for the steel piece, $5398.50 becomes $7454.22. Thus on the investment in 1948 dollars, to equal 1949 production on 1924 equipment would be 1.83 times as great.

Multiple spindle units have been a spectacular example of production cost saving. An automotive company ground the four main bearings of a crankshaft on four separate single-wheel grinders. Each machine produced 60 pieces per day, a total of 240 pieces, at a cost of 64 cents per shaft. A new machine, costing $48,000, now produces 250 pieces per day, at a direct labor cost of 16 cents each. Labor cost was cut from $153.60 for 240 pieces, to $38.40—a saving of $115.20 per day or $30,000 per year. Thus the machine paid for itself in 1.6 years and saved 62.1 percent per year. This figure did not make allowance for reduced scrap or recovered floor space.

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Bulletin 8265 Valve for Pressures up to 250 psi

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WATER

Bulletin 8268 Valve for Pressures up to 350 psi

These ASCO Valves are small and compact with ample reserve power and large safety factors. Each is available with resilient seat and disc construction to assure absolute bubble-tight seating. The sturdy construction permits exceptionally fast and controlled operation.

Both valves have important "approvals". Bulletin 8265 valve is approved by Factory Mutual and Underwriters' Laboratories; Bulletin 8268 Valve is available with explosion-proof solenoid approved by Underwriters' for Class 1, Group D, Hazardous Locations.

Back of these and the many other ASCO Valves is more than 40 years' experience in the design, manufacture and application of solenoid valves. We know this field thoroughly and will be glad to serve you on any automatic control requirement. The above valves are for general purpose use in automatically shutting off the flow of gas, oil or water.

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Useful Literature

The publications listed are available without charge. Mark the initial key number on the card bound in this issue and mail.

28. Felt Application Booklet . . . The 40-page booklet, "Felts for Sealing and Lubricating Bearings", published by The Felters Company, Inc., is designed to acquaint engineers, designers and others interested in the various properties of felts with the many different methods of using felt, both common, established applications and others which represent a departure from common practice. The booklet is well illustrated with many types of seals and uses of felt as distributors of lubrication. Tables give full S.A.E. felt specifications and recommended uses.

29. Energizable Lubricant . . . Nordstrom Valve Division, Rockwell Manufacturing Co., announce a new energizable, automatic lubricant for plug valve lubrication. Hypermatic, available in eight types and grades, draws energy from pressure used in injecting it into the valve, either in stick or grease gun application. It is both compressive and expansive, will hold pressure and keep valves fully lubricated over long periods. Maintenance and servicing is said to be drastically reduced. The new lubricant is applicable to all types of Nordstrom lubricated valves.

30. Data Book on "O" Rings . . . The first edition of the Data Book on Synthetic Rubber "O" Rings and Lathe Cut Washers is available from Acadia Synthetic Products Division, Western Felt Works. Specifications for standard and special size "O" rings for three series, lathe cut static seals and static square seals for rectangular bore are given. Installation suggestions, recommendations on stretch and squeeze and evaluation of Acadia compound for standard and special size "O" rings against AMS-3228-B and 3227-B are listed.

31. Hand Operated Control Valve . . . Bulletin DC-204, issued by National Pneumatic Company, gives specifications, construction and operating features and illustrates a few of the uses to which their four-way hand operated control valve can be adapted. The valve, designed to control any type of air cylinder, may be used also as a three-way valve by plugging one of the pressure ports. Methods of operation, including port plugging, is illustrated by diagrams.

32. Oil Reclaimer . . . Bulletin R-160, issued by The Hilliard Corporation, describes the Hilco Oil Reclaimer, particularly effective when hydraulic oils become contaminated with unusually large quantities of moisture. The unit combines the vacuum vaporization process with filtration to remove volatide contaminants as well as suspended solids. Full specifications and size recommendations are given.

33. Flexible Couplings . . . Catalog No. 57 showing the complete line of new series "A" improved gear type couplings they offer, has been issued by John Waldron Corporation. Standard double engagement type, heavy duty mill, mill motor and floating shaft types are shown with specifications and dimensional drawings. A number of special types—Jordan, shear pin, cut-out, spacer and oil collector among others, are also shown. A number of representative installations are illustrated.

34. Flexible Hose Assemblies . . . A new four-page bulletin just issued by Resistoflex Corporation on their synthetic, solvent-proof products, compartubed flexible hose assemblies for orig-

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inal equipment, cites typical uses for which Resistoflex hose assemblies are especially suited, such as hydraulic, lubrication and others. In addition to regular lines, the company emphasizes their custom service for developing constructions to meet special requirements.

35. Filtering Equipment . . . Four page Bulletin F-49, issued by Alsop Engineering Corporation, illustrates and describes the "Sealed-Disc" all purpose filter and the "Disc-Pak" cartridge type filter and the asbestos discs made by this company. Portable rotary pump units, centrifugal pumps, mixing and tank equipment are also shown.

CIRCLE NUMBERS ON THE CARD AND MAIL!

36. Tube Fittings Catalog . . . The new 60-page Parker Catalog No. 203, the "most complete line of tube fittings in industry", has just been published by The Parker Appliance Co. Design data, specifications, materials and general dimensional data are listed for each of four types of fittings for hydraulic and fluid-handling systems; each fitting shape is illustrated by drawing and photo and dimensions are tabulated for the entire size range. Tubing and tube fabricating equipment and accessories are also described and illustrated.

37. Time Delay Relay . . . Bulletin 800G on their Type TEC time delay relay is available from The R. W. Cramer Co., Inc. The four-page bulletin lists distinctive advantages, application suggestions. Circuit table and wiring diagrams and time ranges are given. Type TER, which differs from type TEC in that the clutch must be momentarily energized at the end of the cycle to return the timer to its starting position, is also described.

38. Self-Synchronous Systems . . . The Ford Instrument Company, division of the Sperry Corporation, has issued a 16-page loose-leaf catalog on the "Telesyn" units and systems for the transmission of shaft rotation values and voltage phase/magnitude patterns over distances economically impractical by any other means. Two major classes are shown: generator and motor (receiver) and generator and control transformer (receiver). Specifications and application suggestions are given for generators, motors, differential generators, differential motors and control transformers.

39. Valve Bulletin . . . Bulletin No. 302 shows in eight, illustrated pages the in-line mounting master valves and pilot valves available from Ross Operating Valve Company. Typical installation diagrams are included. The in-line master valves are designed to boost production by permitting faster machine speeds, to reduce operating costs by consuming less air and to provide for easier operation.

40. Merchandising Catalog . . . The new 1949-1950 edition of its Merchandising Catalog has been issued by Cutler-Hammer, Inc. Illustrated and described are the company's line of safety switches, service control and multibreakers, motor control and electrical specialties.

41. Vibration Control . . . A new bulletin, Catalog ER-701, just released by Korfund Co., Inc., describes Elasto-Rib, a low cost cork and rubber mounting for controlling transmission of vibration and noise. Elasto-Rib has a core of high grade cork plate, bonded between two layers of deep grooved oil resistant Buna-S rubber. Greatest efficiencies are obtained in the recommended loading range of 750 to 5000 lb per sq ft. Methods of installation are described and illustrated. Three types of damper are also described.

42. Packing Standards . . . A new 32-page handbook on Hydraulic and Pneumatic Packing Standards for Leather and Synthetic Rubber has been issued by E. F. Houghton & Co. Prepared by the Hydraulics Engineering Department of this company, the handbook is the first in its field to show the J.I.C. specifications. Written as a supplement to Houghton's two packing handbooks, the new handbook shows the progress already made toward standardization of all types of hydrau-

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lic and pneumatic packings. Specifications for leather and synthetic rubber "V", cup and "O" ring packings and gaskets, leather "U", synthetic rubber "U" cup packings and leather back-up washers for use with "O" ring packings and gaskets are given in detail with J.I.C. dash numbers.

43. "On the Spot" Air . . . A 4-page bulletin just issued by the Kellogg Division, American Brake Shoe Company analyzes the advantages of decentralizing the compressed air system. The economy, operational efficiency, greater flexibility and reduced operating and power costs of "On the Spot" Kellogg-American air are pointed out. A suggested survey for checking your present compressed air system and outstanding features of the Kellogg line of ⅓ to 10 hp compressors are included.

44. Radial Air Compressors . . . Bulletin H-620-B16H, issued by Worthington Pump and Machinery Corporation, describes and illustrates the two-stage, air-cooled, radial type compressors offered by them. One (V3A2) bank and two (V6A2) bank compressors, designed for operating pressures from 80 to 125 psi, are available as bare compressors or base-mounted, the latter in turn available in unabloc, V-belt drive or flexible-coupled units with power source.

45. Air Control Valves . . . Four-page Folder A, issued by Valvair Corporation, shows by brief listings, the two-way, three-way and four-way air valves made by this company. Five sizes—¼, ⅜, ½, ¾ and 1 in sizes—in nine basic designs—knob, lever, foot, cam, clevis, single diaphragm, double diaphragm, single solenoid and double solenoid actuated valves are standard.

46. Flexible Couplings . . . The new Flex-Ring flexible coupling, designed for fractional horsepower service, is described in a bulletin just issued by Smith & Serrell, Inc. The new coupling is compact, shock absorbing, compensating for normal misalignments and has a replaceable center ring. The first size available has bore ¾ in maximum, ⅜ in minimum, set screws and standard key seats. The standard sizes for usual motor drives are shown in this company's Bulletin No. 51.

47. Instrument and Control Catalog . . . A completely new 24-page illustrated catalog, No. 50, on a wide variety of primary and secondary flow instruments and control valves, has been issued by Fischer & Porter Company. Illustrated and described are variable-area primary flow meters, frictionless, series-resonant circuit electrical transmitters, "Rato-matic" flow rate recorders, controllers and ratio controllers, control systems and Flowrator direct-connected recorders, controllers and pneumatic transmitters. Also covered are the new, improved "Pneumatrol" air-operated control mechanism and the "Valvrator" air-operated, diaphragm motor valves.

48. Precision Snap Switch . . . Engineering data sheets on the Class 9007 precision snap switch has been issued by Square D Company. The switch is designed for the number of applications between the sensitive small switches and the much larger machine tool limit switches. Arrangements available are single pole, single throw (normally open or normally closed) or single pole, double throw.

49. Fluid Magnetic Clutches . . . The standard models of FM torque controllers made by Duncan & Bailey, Inc., are described in their booklet, "Fluid Magnetic Clutches". The clutches, essentially proportional torque controllers independent of speed, providing a new controlling means, the low controlling power making it possible to control relatively large amounts of working torque with minimum vacuum tube net works. Design features, installation diagrams, performance charts and a list of industrial uses are included.

50. Extreme Pressure Lubricant... A new four-page bulletin No. 52 issued by The Alpha Corporation, describes Molykote, the extreme pressure lubricant they offer. A specially prepared smooth-textured molybdenum-disulfide compound powder, the lubricant possesses unusual capacity to prevent galling and seizing, excellent chemical and thermal stability, high film strength and, when used as an additive to oils and greases, it is an excellent assembly or break-in lubricant.

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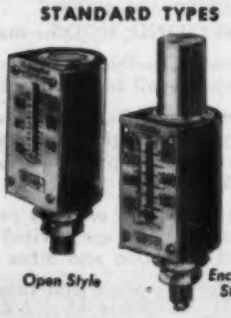

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POST SCRIPTS OF INDUSTRY

NEWS · VIEWS · TRENDS

Plastic and Rubber Products, Inc., announce two new distributorships—Associated Rubber Products Co. in St. Louis, headed by Eugene H. Neupert and Melvin W. Feldman, and Miller Rubber Sales Co. has been appointed distributor in the Twin Cities and surrounding area. Both distributors will carry good stocks of "O" rings.

Compressed Air Products, distributors of hydraulic and air systems and components announce their move to new and larger quarters at 1977 Springfield Ave., Maplewood, N. J.

Lloyd Wolf has been appointed chief engineer in charge of the Twin Disc Clutch Company's Engineering Department at Racine, Wis., according to an announcement by N. F. Adamson, vice president. Wolf has been with the company since 1947 as chief development engineer.

Frank G. Helander has been named executive vice president of Watson-Stillman Company, according to an announcement by E. A. Stillman, president. Helander joined Watson-Stillman in 1943 as midwest sales manager of the Hydraulic Machinery Division with headquarters in Chicago.

Hal W. Reynolds Co., 2902 Euclid Ave., Cleveland, Ohio, has been named exclusive representative of B. C. Ames Co. in northern Ohio.

The Texas Company has renewed its graduate fellowship in Chemical Engineering at Cornell University, according to an announcement by F. H. Rhodes, director of the School of

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At a Fraction Of Its Original Cost

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GENERAL USAGE: As an electric motor driven type pressure generator in an oil hydraulic circuit where a non-pulsating flow of fluid under continuous pressure, but varying volume is desired.

OPERATION: Pump operates at a maximum volume up to a pressure setting, which may be adjusted to any value between 600 and 900 P.S.I. by the pressure adjusting screw. A pressure rise of 100 P.S.I. above this setting will occur as the volume of oil required is reduced from maximum to zero.

The pump housing serves as reservoir for the Hydraulic System and has a built-in compressed air supercharging chamber making the system entirely independent of atmospheric pressure. Integral relief valve is set to open at approximately 1100 P.S.I. HAND OF ROTATION is left hand, and is not reversible. PUMP SPEED: Maximum recommended speed for continuous duty operation—3750 RPM . . . DISPLACEMENT—.484 cu. in./Rev. . . . Volumetric Efficiency at average speed and pressure (approximate)—95%. INLET and OUTLET CONNECTIONS are standard S.A.E. ⅜" tubing parts. WEIGHT—14.0 lbs. . . . RESERVOIR CAPACITY (approximate)—0.4 gals.

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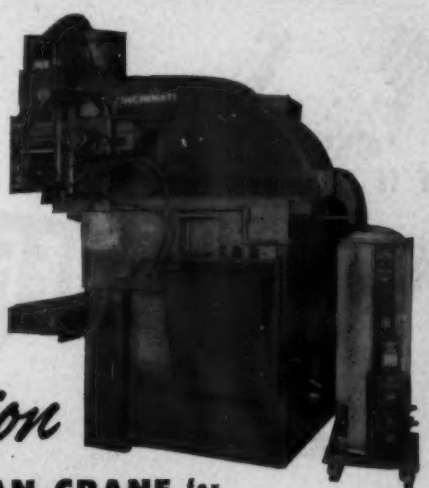

Champion uses **HONAN-CRANE** for **HYDRAULIC OILS on HYDRO-TELS**

Champion Machine and Forge Company, Cleveland, uses Honan-Crane oil purification equipment to keep hydraulic oils clean in Champion's nine Hydrotels used for die-sinking.

Honan-Crane is also called on for oil purification in the 1,500-ton hydraulic presses used to trim Champion's forgings. After one and one-half years continuous operation—no noticeable sludge.

For full information on low cost purification and maintenance of hydraulic oils, write Honan-Crane Corp., 102 Wabash Avenue, Lebanon, Indiana, subsidiary of Houdaille-Hershey Corporation.

Chemical and Metallurgical Engineering, Cornell University. Research on films of evaporated metals on glass or quartz tubes to determine better and more efficient design of heat transfer equipment will be continued.

Louis R. Ripley has been elected president of the Heli-Coil Corporation, Long Island City, New York.

Horace A. Thompson, Jr., who operates the Thompson Equipment Company in New Orleans, La., has been appointed as a dealer by the Hammel-Dahl Company of Providence, R. I., manufacturers of automatic control valves.

Michael J. Phillips has been appointed general manager of the newly formed Industral Division of Greer Hydraulics, Inc. Phillips, whose association in industry has included Commander of the Production Division, Navy Bureau of Aeronautics, assistant to the president of Jack & Heintz Precision Industries, Inc., assistant chief engineer of Pesco Products and manufacturing vice president of Universal Business Machine Company, will supervise the production and marketing of Greer Hydro-pneumatic accumulators and other hydraulic components for industry.

Irving B. Moore Company, 65 High Street, Boston, Mass., has been appointed distributor for "O" rings by The Parker Appliance Company.

Arthur S. Brown was appointed president at a recent meeting of the board of directors of The Clapp Instrument Company, Webster, Mass. At the same time Charles Clift was appointed treasurer and T. W. Lanman, vice president. Brown, whose wide experience includes association with several instrument and control manufacturers, has been acting as general manager of the company.

The mobile "College of Cylinder Knowledge" (September issue, page 14) has toured the Far West, the Detroit, Cleveland, Pittsburgh, Philadelphia areas and New England States. Revisits to this area are planned. The unit is now home in Chicago, and will next visit the Middle Western States.

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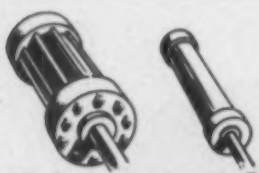

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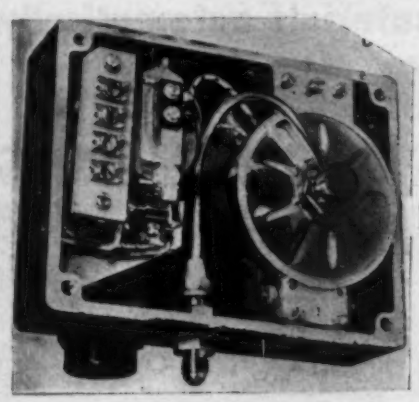

A Pressure Switch that operates in Reverse

The Model 510 Meletron pressure operated switch is used to prevent an operation until the control pressure has decreased to the desired value—thus, it operates in the reverse of the usual manner. The pressure sensing element will operate the micro switch with a change of only 0.1" of mercury from ambient and will withstand a static pressure of 150 psi.

It has a sealed cast aluminum housing which excludes dirt and moisture. The air passage through the conduit is adequate to equalize the pressure between the interior and exterior of the case. Condensation that might occur because of temperature or humidity changes is prevented by the long path of connecting conduit.

Write for further information.

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